SIXTY-SEVENTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV. NUMBER 25.] NEW YORK, DECEMBER 16, 1911 [10 CENTS A COPY $3.00 A YEAR

The fixed structure is high enough to clear the river traffic. The car is suspended at ground level and is hauled across by cable and electric motor under control of the pilot.

NOVEL TRANSPORTER BRIDGE OVER THE RIVER TEES.—[See page 556.]

# SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, DECEMBER 16, 1911

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary and Treasurer; all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter



**Subscription Rates**

Subscription one year . . . . . $5.00
Postage prepaid in United States and possessions, Mexico, Cuba, and Panama

Subscriptions for Foreign Countries, one year, postage prepaid, 4.50
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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## "Made in Germany"

TIME and time again the statement is made that Germany is the most scientific country in the world, scientific not simply in the sense that she has produced some of the most eminent chemists, physicists, biologists and physicians of modern times, but scientific in the fact that she has developed a system of commercially utilizing the immense amount of learning stored up in professorial brains. We in America have the reputation of being the most practical people in the world, of converting into dollars, by the most ingenious machinery ever devised, the unsurpassed natural resources of a continent. Yet if we compare the manner in which we have obtained the commercial respect of Europe, with the manner in which Germany has wrested from England a part of that export trade upon which the very life of England depends, we must concede that we have become prosperous largely through the bounty of Nature. With coal mines that must be worked at depths that tax all the resources of modern engineering, with forests that cannot compare even with the remnants of those that have been left to us by rapacious lumber companies, with ore beds so limited in extent that iron must be imported in huge quantities from other countries, Germany has succeeded, in the short space of forty years, in becoming one of the most powerful industrial nations in the world.

And this she has accomplished not in an accidental, hap-hazard way, but consciously and systematically. The work that her generals accomplished in France in 1871 has been supplemented by the scientific generals of peace, by statesmen, university professors, doctors, and chemists, who planned a policy of commercial development that would answer not simply the needs of to-day, but the needs of a generation to come. In 1876, the late Prof. Reuleaux came to this country as a German commissioner to the Philadelphia Exposition—one of the first opportunities seized by the newly-formed empire to show its industrial strength. Reuleaux cast one despairing glance over the German exhibits, and promptly cabled to Bismarck: "Our goods are cheap, but wretched." That cablegram worked an industrial revolution. "Made in Germany" now means something more than mere cheapness.

How much real science is embodied in that catch phrase "Made in Germany," we intend to show in a series of articles which will appear in early issues of the SCIENTIFIC AMERICAN. To gather the information necessary for a series of articles so broad in scope, we sent our managing editor abroad to make a first-hand study of German commercial life and the part that science plays in governing cities and conducting a business.

Germany and German commerce are favorite topics of discussion these days, but there are phases of German commercial activity which, as we are to see, are only too little known to Americans. The Government's own relation to science, for example, as it is embodied in the work done by the Koenigliche Material-Pruefungsamt, near Berlin, is probably not fully appreciated in this country. Where, for example, would it be possible for a manufacturer of coats or of shoes to have his products scientifically analyzed by an impartial board of experts for a small sum of money and critically compared with the similar products of foreign and domestic manufacturers, all for the purpose that he may profit by the comparison, and with him German industry at large? Where, in all the world, is there a counterpart to the remarkable technologic museum at Munich, a public institution where a man may study chemistry, engineering, optics, physics, weaving, printing, with the aid of apparatus that he himself can set in motion? Where in America will we find the art of governing a city reduced to such a science, that it becomes possible for a municipality to operate its own railways, its own electric light plant, its own gas and water works, and to rent land, all with a profit? Where will we find a workman so scientifically cared for that his health, his hours of labor, his housing, his old age, are made subjects of the most paternal governmental concern? Where in America, with the isolated exception of the Chicago stockyards, will we find the by-products of an industry so completely utilized in building up vast industries that it is difficult sometimes to find a by-product to be converted into a useful article of manufacture?

We are not blind to the fact that, thanks to our youth and courage, Americans have created industries that overshadow in vastness anything that the old world has to offer; nor to the fact that it would be difficult, if not impossible, for a republic necessarily sensitive to every popular whim, to plan its own industrial and political development as scientifically as stolid monarchic Germany has done; nor lastly, to the fact that even enlightened Germans themselves are beginning to recognize that too much scientific education, too much scientific planning, too much governmental control, may clog the mind, and prevent a buoyant exercise of a man's powers. If there is little real daring in German enterprises, little of the adventurous buccaneering spirit that prompts an American to stake everything upon one cast of the industrial die, the reason is to be found not in any lack of courage in the German, but in his education and in his orderly mode of doing business. Scientific discoveries are rarely made by pouring the contents of one test tube into another at haphazard. Neither are many business enterprises successful simply because a manufacturer is willing to leap into the dark. The German takes no chances. His education has taught him the value of logical procedure in business as well as in the laboratory. We hope by publishing the articles in question to show the American manufacturer that a chemist or a physician, or a bacteriologist, may mean more in the upbuilding of his own business than a new piece of machinery, or a reduction in the scale of wages, or a cheapening of the rates of transportation. We Americans are beginning to realize that we must husband our natural resources that the days of reckless extravagance in the use of raw materials are over. In a few years, many a small manufacturer will wonder why it is that he has been forced into bankruptcy. He will attribute it, no doubt, to that keenness of competition which it now seems the purpose of our Government to restore to its medieval glory, and perhaps to his inability to cope with vast aggregations of capital. He will probably attribute his downfall not to the money of his rivals, but to his own inability to utilize his raw material with Teutonic and scientific completeness, to get the most out of a shovelful of coal and a handful of corn.

Germany owes her commercial success to her remarkable system of education, to the Government's co-operation with manufacturers; and lastly, to that army of men who watch the boiling of many colored liquids in glass retorts, whose eyes are glued to microscopes day in and day out, and who make everything according to a scientific method, whether it be a battleship or a tin whistle. The story of that success is a story of science, a story that we intend to tell in the SCIENTIFIC AMERICAN.

## Physical Tests for Aviators

THE physical testing of engine-drivers and other employees has long been an established policy of railroads. It has been recognized that the safety of hundreds of lives and of thousands of dollars worth of property may depend not only upon the skill and endurance of one man, but upon his physical fitness for his task.

Moreover, defects may exist in either sight or hearing of which the victim is himself more or less unconscious. Keenness of vision and sensitiveness of color perception, for example, are requisites in the case of engineers, switchmen, and others. Yet either may be impaired or congenitally defective, and the man never know it. A very remarkable instance of this is the case of the redoubtable General Lee Christmas, who is said to have been driven by his inability to distinguish signals of differing colors to his picturesque and sensational career as a soldier of fortune through his overwhelming disappointment and despair at finding himself cut off from his cherished ambition of becoming a railroad engineer.

Thus far the chauffeurs of automobiles have not been subjected to similar tests. In fact, it is only of late that there has been a strong public demand for certified proof of a reasonable amount of mechanical knowledge and experience in driving on their part. Yet it is probable that many collisions and other accidents have been due to some bodily infirmity of the driver.

But if a proper corporeal equipment is necessary to the motor-car driver or the engineer moving in one plane and in tolerably uniform conditions, it is absolutely essential to the air-pilot, who must move in three dimensions and who is subject to the most varying conditions of temperature, humidity, and air-pressure.

"Know thyself" becomes the very law of life to the aviator, and doubtless much of the appalling loss of life among aeroplanists might have been avoided had the too reckless birdmen been aware of their own physical defects and limitations. Now that the aeroplane has demonstrated its ability to carry a very considerable number of passengers—a Sommer biplane has recently carried six full-grown passengers on an hour's trip across country—public policy demands that a physician's certificate of physical soundness be required of applicants for a pilot's license.

A special study of this subject has been made recently by an Italian physician, who has reported some very interesting conclusions to the *Hospital Gazette*. As a first requirement he observes that would-be pilots should have perfect functional action of the organs of the respiratory and circulatory systems, and of the nerve-centers, since all of these must be subjected to great exertion, strain, and disturbance.

Precision of movement of the limbs is highly important, and so is the ability to jump or leap with accuracy, a quality which depends not only on legaction, but on flexibility of trunk and clearness of sight. Resistance to shock should also be tested, as should keenness of vision for white and for colors.

Soundness of the auditory organs is a particularly vital matter. In the first place the hearing should be normal because upon this faculty especially devolves the noting of the proper and uninterrupted action of the motor. Also, a healthy state of the drum and middle ear, the free play of the chain of small bones, and an unobstructed condition of the upper air passages and the Eustachian tubes are indispensable conditions for the defense of the anatomic and functional integrity of the ear against the effects of the variation of the pressure of the air and of sundry meteorological agencies.

Most vital consideration of all, perhaps, is the integrity of the labyrinth of the internal ear, and especially of the three semi-circular canals. It has long been known that these canals, which are disposed in three separate planes, constitute a very delicate organ of equilibrium. The nerve-filaments they contain float in a liquid, any disturbance of whose level is at once conveyed to the brain. The peculiar gyrations of the waltzing mice of Japan are due to an abnormality of these canals.

In this connection Professor Nieddu-Semidei made some especially interesting observations, one to the effect that the sense of dynamic equilibrium is made more sensitive by exercise. In one instance an aspirant for a pilot's license showed marked errors and illusions of direction. On examination of his ears there were found traces of a previous purulent ear-trouble resulting in diminution of hearing and functional trouble of the semi-circular canals. When asked to walk in a straight line with his eyes shut he constantly bore to the right. This deflection was still more marked when walking in an arc of a circle, the circle enlarging at each turn if the trajectory was convex toward the right and decreasing correspondingly if toward the left. The observation of this case led the physician to formulate the circle test for the examination of the functional operation of the semi-circular canals in would-be pilots.

If the pilots of dirigibles and of floating balloons require less rigid tests in some respects, in others they are more liable to disturbance because of the greater heights at which they commonly move and because of the much longer duration of the flight. For them, heart and lung power are of graver import, skin sensitiveness should be considered, and gastric irritability may play a significant part in the diminution of strength and resistance and the general loss of staying power.

# Self-dumping and Automatic Baling Scow

## A New Type for Refuse Disposal and Harbor Construction

THE handling of waste materials and refuse from a great city is a vast problem. When it is understood that New York city must dispose of at least 6,000,000 tons a year, or almost 20,000 tons per day, and that all or nearly all of this material must be transported to sea and dumped in not less than twelve fathoms or 72 feet of water, which means a tow of from 22 to 25 miles from the Battery, some idea will be gained of the magnitude of the undertaking.

At the present time and for a number of years in the future there will be added to this a vast quantity of excavation resulting from subways.

While a considerable portion of this material is transported within the harbor limits and used for solid fill in reclaiming waste land and shallow water, all of it will have to be transported on some kind of water craft. At the present time there are only two classes of vessels handling this material—the ordinary deck scow carrying the material upon the flat deck, from which it is unloaded either by hand or mechanical device, usually a grab bucket, and the so-called dump scow or bottom dumper, constructed with certain pockets or openings through the center which are closed by swinging doors in the bottom, retained in place by chains and mechanical devices. Into these pockets the material to be transported is delivered, and when the scow has been removed to sea or to some other part of the harbor where the material is to be used, the gates are opened and the material delivered through the bottom.

While each of these devices is particularly fitted to do the work for which it was designed, neither can do the work of the other. The unloading of the deck scow is a slow and tedious matter, either by hand or with mechanical device, and it is practically impossible to unload the dump scow otherwise than through the bottom. The dump scow is further handicapped by not being able to handle certain material, such as earth containing more than ten per cent of rock or mixed with boards, timbers or other refuse, which would either bridge across the openings when the bottom doors are opened or fail to leave the scow through the bottom, due to entanglement or a tendency to float. The bottom dumper is further handicapped by the fact that if loaded in very cold weather, the bottom layers will freeze and the whole mass gradually assume such a condition as to be immovable until warm weather returns, or, as a last resort, by the use of dynamite, which will more often destroy the scow and render it useless without extensive repair.

The reluctance of the bottom dumper to deliver all of its material through the bottom, has given rise to the practice of the towing captains called "bumping," which means, after the gates have been opened and the material refuses to leave, the tug is used as a battering ram, repeatedly butting into or bumping against the scow to dislodge the reluctant material. As the unloading usually occurs at night and far out at sea, often in heavy weather, and as the captain dislikes very much to return to port with half a cargo, the practice often results in discharging some of it through the hole made by the tug. Besides the work of handling refuse from cities, there is a vast amount of work in handling rock for breakwaters in making new harbors and improving old ones.

The craft herewith illustrated is intended to retain the deck-loading feature of the ordinary deck scow and to make possible a very much superior and more certain means of unloading. In other words, the material is loaded on the deck in the ordinary manner and towed to any place within the harbor, and the material removed by mechanical means from the deck; or it may be towed to sea, when, by the manipulation of certain valves from the interior, it will turn completely over, depositing material positively and quickly and with every assurance that none of the load will be brought back.

By referring to the drawings it will be seen that the scow is practically rectangular in cross-section, with rounded ends. As it is intended to work either side up, the bow is required to be vertical. The interior is divided by four longitudinal watertight bulkheads, one near each bow, extending from the bottom to the top of the scow, and two intermediate bulkheads extending between two false bottoms which are located from six to nine inches above the light draught water line of the scow.

The scow is framed longitudinally with heavy trusses on four feet centers, well braced diagonally and secured vertically with tie rods. The framing is of exceptionally heavy scantling throughout, well braced and stiffened with knees and breast hooks at bow and stern.

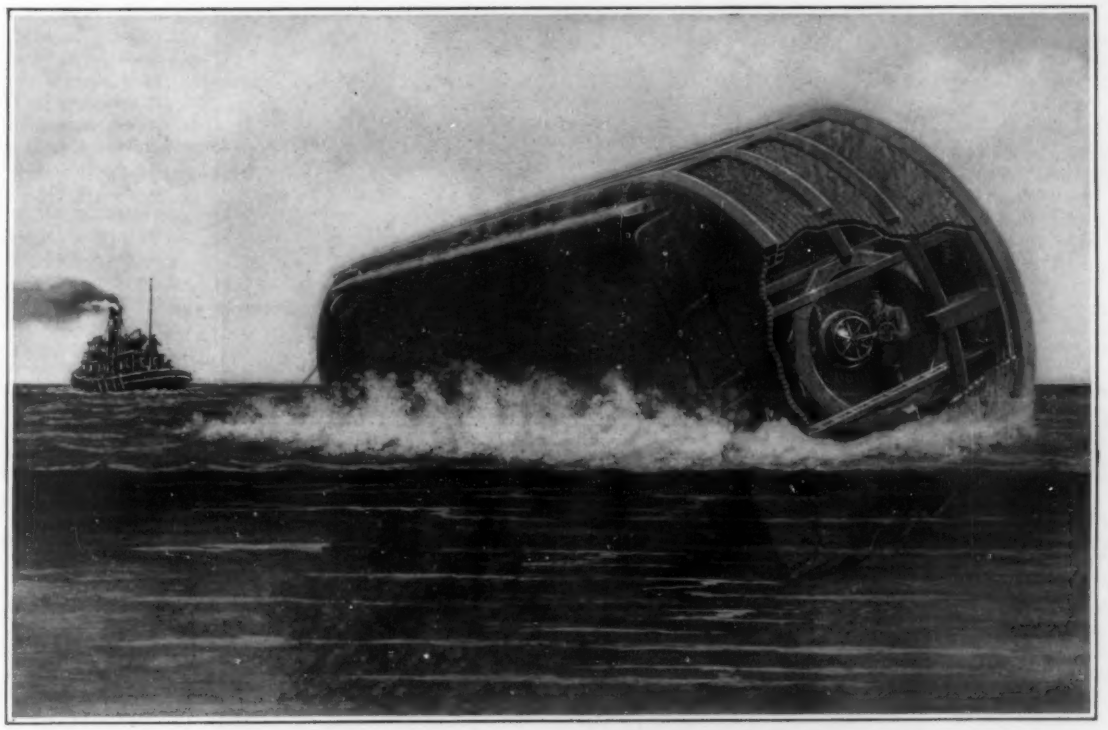
The larger drawing shows the operating machinery. Considering the scow as loaded down to full load line with two feet freeboard, the operating wheel in the drum is turned, and through the transmission mechanism the valves are opened, admitting water to the space between the two false bottoms. This water, being free to flow from side to side, gathers at one side and gradually lists the scow until it assumes the position shown in the third of the smaller engravings, where it has about reached the point of unstable equilibrium. The continued entrance of the water causes the scow to gradually turn up on edge, and finally fall over to the position shown in the fourth of the small engravings, finally coming to rest in the reversed position.

There are valves or openings near the top and bottom of each compartment. All these valves are opened at the same time, the upper valves, when the scow is loaded, allowing the air to escape as the water enters at the lower openings.

When the scow has reversed itself, the water which has entered will run out through the lower openings, due to the fact that the reserve buoyancy below the false bottom is sufficient to raise the bottom or deck six or eight inches above the light water line, after which the valves may be left open and closed at any time before the scow is reloaded.

Perhaps the most novel feature of this scow is the arrangement by which it is possible for the operator to remain within the scow while it is being reversed; and it was, of course, a matter of great interest as to how rapidly the scow would turn. Repeated timing has shown that from the time the valves are opened until the scow assumes the vertical position on edge, fifteen seconds elapse.

As the drum is 8 feet in diameter, during this time the operator has to move one quarter of the revolution or 6 feet, and while the remaining quarter turn is completed in from two to three seconds, the operator travels another 6 feet around the circumference of the drum, steadying himself by grasping the central spindle about which the operating wheel turns. The whole turning movement is surprisingly slow and deliberate.

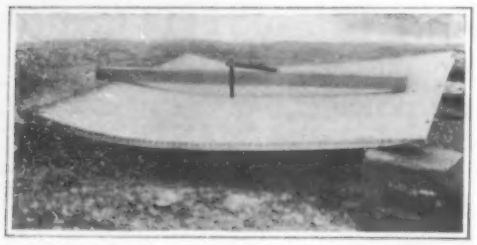


NEW TYPE OF SELF-DUMPING SCOW

### Severe Hailstorms

THE destructive effects of large hailstones are most frequently experienced in subtropical regions at a considerable altitude above sea-level. Some of the most severe hailstorms have occurred in India. At Belgium, December 22nd, 1884, 12 persons were killed, 78 injured, and 170 head of cattle and 560 sheep destroyed by hail. In the State of Bhor, October 5th, 1893, the hail covered the ground to the depth of 4 to 6 feet; 6 persons were buried beneath it and perished, while 835 head of cattle were killed. The most severe of these visitations occurred May 1st, 1888, when in the Moradabad district alone about 250 persons perished.

In the United States one of the worst storms of this character occurred September 5th, 1898, in Nodoway County, Missouri. The path of the storm was about three miles wide and eighteen miles long, its greatest violence being felt over a region of four square miles east of Clarmont. At one point in this region the fall of hail was so heavy that a drift unprotected by any artificial means remained lying on the ground for four weeks after the storm. At the end of that time people in the neighborhood were found gathering the hail for the purpose of making ice cream. During the storm cylindrical pieces of ice were picked up four inches long by about two and a half in diameter. The growing corn was practically all destroyed; in a field of eighty acres only one stalk was left standing.



Noting the deflection of the plane.

# The Strength of an Aeroplane

## A Family Hydroplane

A plane loaded with gravel.

SINCE the successful launching on September 7th, 1911, of the hydro-aeroplane of the United States Navy, by sliding it down a wire, Mr. Curtiss has given his attention to new experiments in aviation of no less interest.

On October 2nd he made a test of the stresses in the stay wires of all the panels of the main sustaining surfaces of his standard biplane, in order to compare them with the stresses, determined by computation and by graphical construction. To this end he turned the aeroplane upside down, supported it at its middle, and loaded the entire main planes with sand distributed in such manner as to produce in the guy wires the same stress as in ordinary flight.

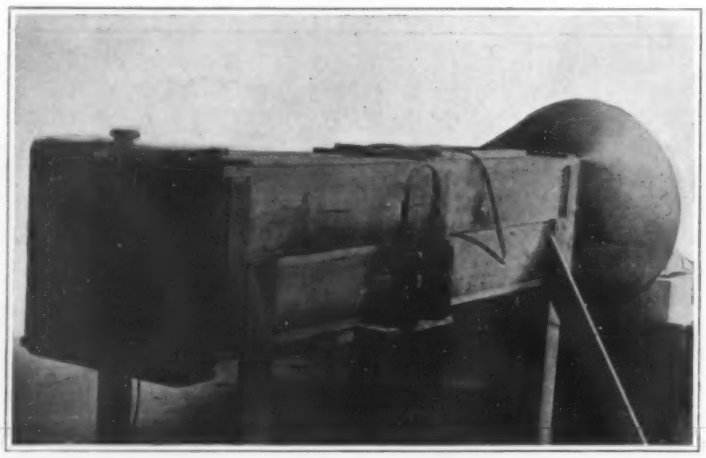
When subject to their full stress each wire was tested by means of a pair of tension tongs. These look like ordinary blacksmith tongs except that each jaw is slitted so as to pass over the wire to be tested and grip it when the slits are closed by tightening screws. When the jaws were thus attached to a wire, the handles of the tension tongs were drawn together just enough to cause the bit of wire between the jaws to lose its stress, and slacken. The force on the long handles was then measured by a spring balance, which in fact caused them to exert the required stress, and the tension in the wire was found directly as the product of the force indicated by the spring balance multiplied by the ratio of the distances from the tongs pivot respectively to the spring balance and to the wire under test.

It had been previously shown by analysis and by graphic statistics, that in a biplane whose surfaces have practically a uniform running load from center to either wing tip, as may be roughly assumed to be true in ordinary usage, the stress in the outwardly and upwardly sloping stay wires of the end panels, or wing tips, sustain but one-fourth as much tension as the corresponding wires in the second panels from the end, while those wires which slope outwardly and downwardly sustain no material tension due to pressure on the concave side of the wings, though they may be very severely strained when the machine is jolting over rough ground. In the third section from either wing tip, known as the engine section, the tension in the guy wires and oblique stay rods is still greater, being more than five times the tension in the wires of the end panels.

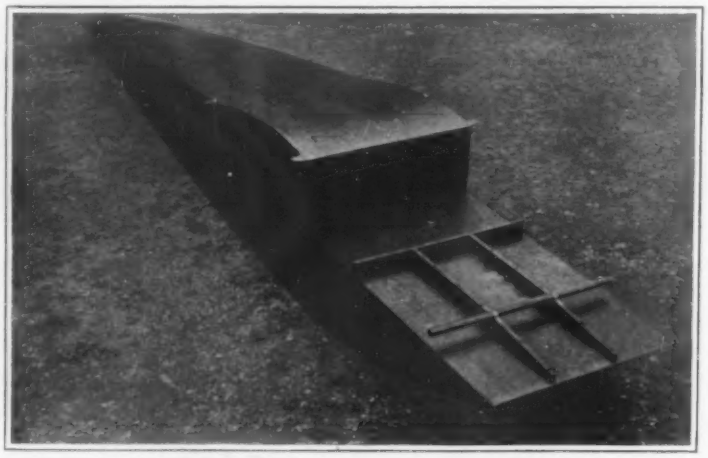
Though the test was made for practical rather than scientific purposes, the stresses were found to increase from the wing ends to the engine section approximately as indicated by theory. It was observed also that each wire had a large factor of safety, ranging from about ten to thirty. Mr. Curtiss then added his weight of 150 pounds to one wing tip, while an assistant of equal weight stood on the other wing end. The stress in the wires of the second panel was then doubled.

Other tests were made on the ribs of the main planes. It was noticed that they were sprung by the load of sand sufficiently to change the tension perceptibly in the fore-and-aft diagonal wires. Mr. Curtiss had a panel of the main planes placed upside down with its spars resting on trestles placed transversely to the ribs. When uniformly loaded with sand weighing ten times the usual pressure on the wings, these collapsed, due to breakage of the ribs. From these various tests it was concluded that the weakest part can endure ten times the stress it usually has to sustain in ordinary flight.

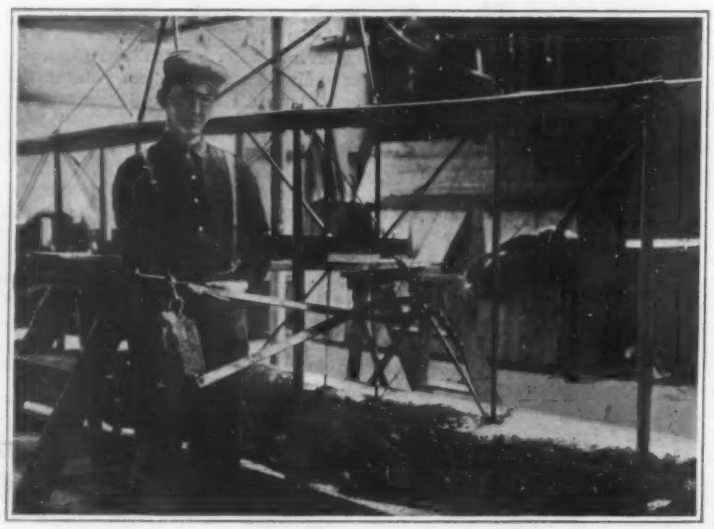
During the month of October Mr. Curtiss developed a new type of hydro-aeroplane, intended for pleasure and sociability. This has been called a "family hydro." The machine consists of a biplane mounted directly on a single boat of unusual size, without intermediate framing, so that the lower plane rests directly on top of the boat amidships. The passengers will sit on the bow of the boat just before the lower plane. The engine will be mounted just underneath the upper plane so as to allow the propeller on its crankshaft to swing freely without too near exposure to the back of the boat and the spray thrown up when the latter is skimming the water rapidly. The usual floats at the wing ends will be used to preserve the lateral balance when the vessel rests quietly on the water, or runs over its surface. The final goal is an aeroplane which can be manipulated as readily as a motor boat, which can be launched from smooth or rough water alike, and which, after a substantial voyage in the air, may be landed on earth or water with ease and security. A novel wind-tube for studies in aerodynamics was developed in the Curtiss aeroplane factory during October, 1911, and found its first application in revealing the stream-lines about the wings and body of a small model of the new hydro-aeroplane. The wind-tube, which is but the model of a full-sized wind-tunnel to be built later, is shown in the photograph. It measures six feet in length by fifteen inches square in cross-section, and is provided with a glass door through which models can be introduced and studied in the air stream. As usual the current of air is generated by an electric motor driving a suction fan or screw at one end of the tube, while at the other end is inserted a honeycomb structure for causing the air to flow in straight lines free from swirls and eddies. The "honeycomb" in this case is a standard aeroplane radiator having cells four inches long by one-fourth inch square in cross-section. The air enters the tube through this straightener at a part of the room free from obstructions and well above the floor. As a consequence it moves in a smooth current of uniform velocity. A fine silk thread suspended in the current shows a deviation of the stream-lines of but a small fraction of a degree to and fro from exact parallelism with the walls of the tube. The speed of the air, tested when the motor was not perfectly steady, showed a diminution of nearly two per cent across the tube at the middle of the window, when explored from mid section to within less than two inches of the walls; but in the stratum extending from the walls inwardly 1.5 inch, a considerable variation of wind speed was observable, due no doubt to skin friction on the four feet of wall between the radiator and the section in question. A cone was placed at the motor end of the tube to incase the 30-inch suction screw, and a like cone may be placed before the radiator, if thought advisable, to improve the flow of air.



Wind tube with radiator for straightening stream lines.



Peculiar float of the "family" hydroplane.



Testing the tension of the stay wires. The biplane being inverted and loaded with gravel.

This wind-tube is so simple and effective that it may be found serviceable to other aviation students who may wish to make like experiments. But of course it is desirable to have very much larger tubes, equipped with proportionately large radiators, since a small model may easily disturb the stream-lines as far as the walls of a small tube, and thus give different indications from those for freely flowing air. The radiator not only makes an efficient straightener, but also may serve to keep the air at any desired temperature, if a suitable fluid be made to course through it. This remark applies particularly to a wind-tube having a closed circulation of air.

Two methods are used by Mr. Curtiss to delineate the stream-lines of the air current flowing past any model inside the wind-tube. One is to attach a fine silk thread to a fine wire, and hold it at various points about the model; the

(Continued on page 565.)

# Curiosities of Science and Invention

## Rupturing a Current of 800 Amperes at 13,000 Volts

IN a paper recently read before the Pittsfield-Schenectady Mid-year Convention of the American Institute of Electrical Engineers, D. Merriam discussed the problems of oil-break circuit breakers. The oil circuit breaker interrupts an electrical circuit in oil without producing abnormal disturbances in that circuit and also confines the destructive arc to a small volume, thereby preventing its spread to adjacent apparatus and enabling the oil circuit breaker to be safely placed in any convenient location on the switchboard or in the power station. Air break circuit breakers, owing to the large vicious arcs which they produce, are unsuited for general alternating current circuit breaking applications. The illustration herewith shows an arc drawn by one of these devices when opening a circuit carrying 800 amperes at 13,000 volts. This arc, one of many observed, was about 180 inches long and rose 140 inches in the air, while the same circuit ruptured in oil produced an arc only 9 inches long and with no external disturbance.

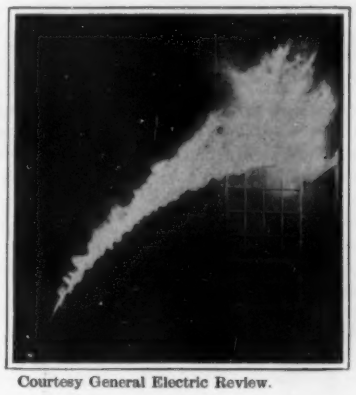
## Pneumatic Spring for Automobiles

WE illustrate herewith a pneumatic cushion which has with considerable success during the past year been used to take the place of springs in automobiles, and which is now being tested on the commercial vehicle. The cushions consist of rubber bulbs, each with an outlet through the neck at the top, connecting with a good-sized air reservoir. The cushions at the front have a separate air tank from those at the rear. A pressure of but 27 pounds is used in the front cushions, which are 8 inches in diameter, whereas 43 pounds to the square inch is the pressure used in the rear 10-inch cushions. This pressure is sufficient to support the weight of a 3½-ton express truck, fully loaded. In the future, a single bulb will be used in place of each spring, these bulbs being 9 inches in diameter in the front, and 12 inches at the rear. According to the superintendent of the express company which has been testing these cushions on one of its trucks for the past two months, the cushions absorb the road vibrations of the running gear and cause the wheels to cling to the ground, giving better traction. The result is twofold—a decided diminution of the wear and tear on the engine and transmission, and longer life of the tires because they do not bounce so much. The saving on the machinery and tires is estimated to be as much as twenty-five per cent in both cases. Another good point of the cushion spring is that it will not crystallize and break as steel springs frequently do. This is a decided advantage, especially with a commercial vehicle, where the breakage of a spring generally causes great delay.

## A Museum of Speech

FOR more than a year, a Parisian professor, Mr. Ponge, has been engaged in creating a very original museum, for the collection and preservation of records of the human voice under all of its manifestations. In this museum of speech there will be in addition to the original records, wax copies and microphotographs of the contour and relief of characteristic phonograms; also studies of the organs of speech as well as photographs of speech (Marage process).

With the help of these data, the museum of speech will make a phonetic chart of French speakers. Thanks to these files it will be possible to notice almost imperceptible differences between the same words in the *patois* of two neighboring villages, or of two successive generations. Just now Mr. Ponge is using the phonograph to preserve the children's songs and the cries of the street as well as the speeches of the great orators, the sermons of the celebrated preachers, the arguments of illustrious members of the bar, etc. One of the photographs shows him at work in a school among the children playing and singing a child's song. Another of our views shows him in the street recording the cry of an asparagus vendor. He has a fertile field for work among street criers. There is the hawker of straw goods, the mender of chairs, the china and porcelain merchant, the cask maker rolling his barrel as he goes along, the glazier and other small merchants whose "speech" he records for minute study.



Courtesy General Electric Review.

A 180-inch arc drawn out by an air switch.

Getting standard time by wireless from the Eiffel Tower.

A 3-ton truck in the express service equipped with pneumatic cushions in place of springs.

Preserving the songs of children at play.

Recording the cry of an asparagus vendor.

## Setting a Watch by Wireless Time Signals

NOW that time signals are being sent out from the Eiffel Tower periodically, amateur wireless telegraphers have seized the opportunity to set their watches by means of these signals. Obviously, this form of signal has its advantages over that of the time ball in common use here. The signal is sent out broadcast and any one may receive it in his own home, not only in Paris, but in suburbs and neighboring towns. The receiving instruments of wireless telegraphy are very simple and inexpensive, and any boy can make them out of materials at hand, practically the only expense being that of a good telephone receiver. The accompanying photograph shows a rather more elaborate set of instruments than is absolutely necessary, and the operator, with telephone to his ear and watch in hand, is waiting for the signal from the Eiffel Tower. A system such as this should do much to set a standard of time over a large area at but little cost.

## Mesmerizing Lobsters

BIZARRE information may occasionally be gleaned from the most serious scientific literature. The title of the *Report of the Northumberland Sea Fisheries Committee for* 1910-11 suggests routine statistics on trawling and seining, sea temperatures and salinity, plankton and the like; hence it is somewhat disconcerting to find therein more or less valuable directions as to the best way to mesmerize lobsters. "The usual method (we quote from *Nature*) is to hold the lobster head down, with the claws arranged so as to form a support with the rostrum, and to stroke it rapidly with the tips of the fingers," i. e., to stroke the back of the carapace, or shell covering the crustacean's head and thorax. "In about a minute the lobster succumbs, and remains without movement in this position for a variable period. In order to see whether the reversed position, as driving the blood to the head, was essential, a lobster was treated in the horizontal attitude, and so successfully that it remained without movement for three hours. A Norway lobster subjected to a similar treatment was quiescent for fifty-minutes. A lobster can be put to sleep on its back." Other crustaceans are amenable to the same treatment. "The crab goes to sleep usually in the tucked-up condition, and may be left in the natural position or on its back. They all recover when disturbed; but the recovery of the lobster appears to be quicker if the under surface of the cephalothorax is disturbed. Placed in sea water lobsters recover immediately, but in one such case a crab took ten minutes to come round completely."

The process is beautifully simple, and—such are the vicissitudes of life—one can never tell when the foregoing information might "come in handy."

# Abstracts from Current Periodicals

## Phases of Science as Other Editors See Them

### Living Persons Represented on a Reduced Scale

THE idea of projecting on a screen living figures larger or smaller than life was realized more than a century ago, but the weakness of the available sources of light made the representation very imperfect. Even the electric arc gives unsatisfactory results when lenses and a screen are employed, but by suppressing the screen and forming aerial images by means of concave mirrors, a very brilliant and realistic effect can be produced.

An exhibition of this kind has been on view in Paris during the past year. At one end of a darkened hall is a little stage with a curtain about five feet wide and three feet high. The raising of the curtain reveals a "back drop" and side scenes of the usual type, and personages who move and speak in a very life-like manner, but are only twelve or fifteen inches tall. The following explanation of the trick, which we quote from *La Nature*, is conjectural, as the exhibitors refuse to give any information.

The illusion is probably produced by two concave mirrors which are really above the floor, but are shown below the floor in the diagram, for the sake of clearness. The real actor, indicated by the arrow *AB*, stands before the mirror $M_1$ which forms a reduced and inverted aerial image of him at $A^1B^1$, and the second mirror $M_2$ forms a re-inverted and still further reduced aerial image at *ab*, on the stage, and in view of the spectator *S*. The rays which form the image pass through an opening in the back scene, and the part of the scene which is thus cut out is painted, on a larger scale, on a screen *D*, placed behind the actor *AB*. This part of the scene and a portion of the floor *P* are thus projected with the actor's figure. The actor's movements are necessarily restricted to a small area, but he can make gestures and dancing steps without getting out of range or focus. The illumination, as well as the distances, dimensions and positions, requires very nice adjustment. The actor and the projected scene *D* are necessarily illuminated by a powerful electric arc, while the back drop and side scenes of the little stage are lighted by rows of incandescent lamps, and the illumination must harmonize in order to produce a realistic effect. These difficult problems have been solved with wonderful success.

### Paintings Locked to the Wall

THE stir occasioned by the recent theft of the "Mona Lisa" from the Louvre has drawn attention to the insufficient protection of paintings, which are simply hung on the walls of our great art galleries, and can be detached by a twist of the hand on the part of a person more enterprising than scrupulous.

The idea occurs naturally enough in some way to lock the paintings to the wall. This is what the inventor of the device shown in our illustration herewith does.

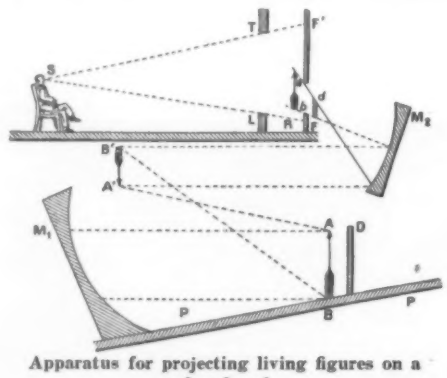
A horizontal bar of rectangular cross-section extends along the wall, its ends being placed in bearings which allow the bar to rotate so as to present either its narrow edge or its flat surface in plan view. The paintings are provided with slotted ears, into which the horizontal locking bar can be inserted when in its "edgewise" position. The bar is then turned flat, and so locked by means of a lever (shown in Figs. 2 and 3). The picture is then held firmly to the wall. The device seems practicable enough, and should find extended use; though possibly to some tastes it may be objectionable, at least for private residences, on esthetic grounds.

### Mining in the Stone Age

A MOST interesting glimpse into prehistoric mining in the Stone Age has recently been revealed upon the opening of the Oural and Aram copper-cobalt mines in Spain according to the *American Antiquarian*.

"In these ancient Spanish mines," states our contemporary, "the galleries and drifts do not open directly onto the mountain side. Instead they communicate with daylight by means of several vertical shafts or chimneys, a few meters in height. The purpose of this arrangement was, it has been suggested, to effect a better control over the slave-miners. Perhaps, too, the purpose was to prevent wild animals from making their home in the mine along with the slaves.

"Relics found both inside and outside the mine comprise bones, and various implements made of stone, bone, horn, fireclay or of wood. Among the principal relics found on the interior were sixteen skeletons, two of them complete; stone hammers; picks made of horns of animals no longer known in Spain; stone needle; torch sticks; a bone knife; two wooden bowls,




**Apparatus for projecting living figures on a reduced scale.**

and, strangely enough, some coins. The skeletons which were found belong for the most part to miners suddenly killed in the midst of their labor; the hand still holds the hammer, and occasionally a skeleton is found under a fall of rock. Other corpses met death in a cowering or crouching position.

"All of the men must have been of extraordinary muscular development. The heavier stone hammers which they used weighed as much as twenty or twenty-two pounds. In spite of their muscular development, the majority of the miners were evidently of extremely slim build, for some of the galleries are literally polished by the rubbing of bones, and in these galleries, penetrating through the solid rock, a man of even small size can worm his way only with the greatest difficulty. The skulls have the appearance of youthful individuals or of children; but, considering the differences in skull and brain development in those days as compared with to-day, this appearance may be deceptive.

"The stone hammers, more or less polished, were often used by being held directly in the hand, without any sort of handle. In some hammers a wooden helve is preserved and in a few a thong served as handle.

"For illumination, the miners used sticks of wood four to eight inches long. A ball of wet clay was rolled and slapped against the gallery wall. Into this clay the miner stuck his little light. Numbers of these wooden sticks or matches, the free end charred, are still preserved in place in their clay holders along the galleries. There are also found some resinous branches or twigs, wrapped in hide, and the latter soaked with grease or with resin. These, it is believed, also served for illumination; perhaps, too, for heating purposes.

"Fire was used to splinter the rock, and to render it more friable and easier to attack. The clay along the vein walls was picked away by hand. Thousands of finger prints are still visible here; they show that the thumb of the miner of these days was of tremendous size, almost double the length of the thumb of present-day workmen.

"No props were used in the workings, which fact alone proves that they antedated the Romans. In certain cases ore was extracted from the end of diggings into which to-day only a child would be able to penetrate. Several galleries are so steep and so slippery that any movement in them must have been with the help of thongs fastened into the roof of the gallery; in the vertical stopes or raises there is usually still preserved a stone ring into which such a thong was fastened.

"Originally, the ores were smelted in shallow, scooped-out hollows in refractory clay. These primitive crucibles were about 8 inches in diameter, and with walls 1½ inch thick; fragments of them are preserved with ore, incompletely reduced, clinging to their sides. Later they must have employed a more highly perfected smelting device, for pieces of quite homogeneous slag are found; this denotes the use of some continuous smelting apparatus."

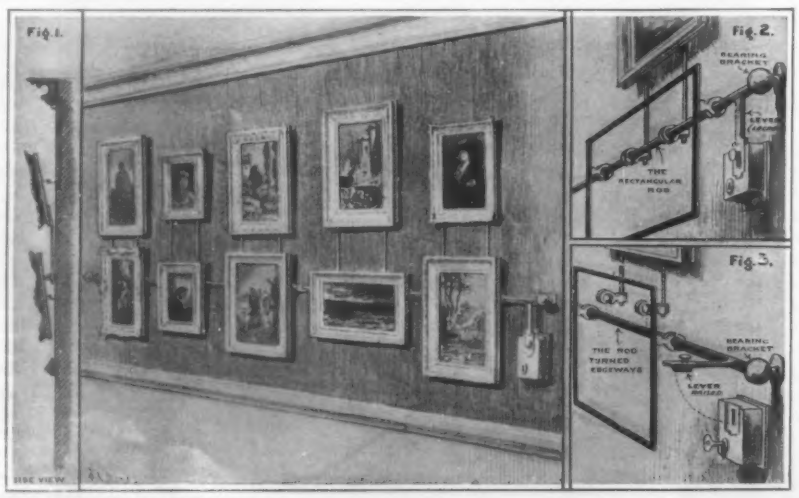
### Was Benjamin Franklin the First Inventor of the Lightning Conductor?

TO some it may seem almost a sacrilege to raise the question which appears at the head of this note. Perhaps it may not be amiss to say right at the outset that investigation of the evidence leads to a substantiation of the ordinarily accepted view which gives to Benjamin Franklin the honor of having invented the lightning conductor. Nevertheless, it is interesting to note a number of passages in ancient literature and records, which have by some been construed as anticipating the modern method of warding off the lightning. This subject is discussed by an anonymous writer in *Die Welt der Technik*.

Very soon after Franklin's invention became known, a French professor drew attention to ancient Tuscan and Roman instructions, which spoke of "calling down" lightning (*elicere*), and further pointed out that the ancient Romans had a regular rite for Jupiter *elicius* (Jupiter called down from heaven). It was argued, therefore, that the Tuscans and Romans knew, even at that early period, of the possibility of drawing down the lightning from the clouds. The Celtic nations also were in the habit of sticking their swords in the earth with the point upward, near springs, on the approach of a thunder storm, as a protection against lightning. The Persian King, Artaxerxes, was acquainted with the power of iron to attract lightning. Again, Josephus Flavius, in describing the great temple of Herod in Jerusalem, states that the roof was studded with an army of golden points, and that a similar arrangement was found on the earlier temples of Solomon and Zerubbabel. It is stated that none of these temples, in spite of their location upon an altitude, was ever struck by the lightning. Coming down to the Middle Ages, it is noted that an edict of Charlemagne mentions that the peasants were in the habit of setting up long pointed poles in the ground on the approach of a storm, and in a sermon of St. Bernardinus of Siena it is mentioned that sailors would bind a sword with its point directed upward to the mast of their vessel on the approach of a storm.

Apparently a very good case could be made against Franklin. Dr. Hennig, however, puts down all instances of this kind to pure superstition. The idea was to frighten away the storm demons by means of the upwardly-directed swords. Among uncivilized peoples it is a common custom to threaten approaching storms by the din of arms, and the ancient Gauls and Romans would shoot arrows into the gathering storm clouds, to ward off the hostile powers of the weather.

As regards the golden points upon the temple at Jerusalem and other places, Josephus himself tells us that the purpose of these points was to keep off the birds.




From London Illustrated News.

**Locking the stable after the horse is gone.—The theft of the "Mona Lisa" has inspired this invention.**

## Engineering

**Work on the "Maine."**—The work of uncovering the "Maine" is completed, and the report of the engineers and the Board who made the investigation has been made to the Secretary. In the opinion of the Board the examination of the bottom of the ship in the region of the explosion presents evidence of a primary explosion external to the ship, and in all the main features, the recent investigations have fully corroborated the report of the Naval Board of Inquiry, made at the time of the disaster.

**Fritz Medal to Sir William H. White.**—At the Nineteenth Annual Dinner of the Society of Naval Architects and Marine Engineers, held at the Waldorf-Astoria, Sir William H. White, former chief constructor of the British navy, was awarded the John Fritz medal for notable achievement in naval architecture. The venerable American steel pioneer, in whose honor the medal was founded in 1902, was present, in spite of his 89 years. Previous recipients of the medal were Lord Kelvin, George Westinghouse, Alexander Graham Bell, Thomas Alva Edison, Charles T. Porter and Alfred Noble.

**Monument to Fitch.**—In connection with the River Centennial Celebration, recently held in Pittsburgh, there has been a movement to give a long-delayed but well-deserved tribute to the work done by that interesting but very erratic character, John Fitch, in promoting the early development of the steamboat. Fitch was a typical American inventor, with all of his characteristic faith and perseverance. His boat was the first to run on a regular schedule, carrying passengers. This is a fact which cannot be disputed. A newly-organized chapter of the Daughters of the American Revolution will be named in Fitch's honor and will erect a suitable monument to his memory.

**Lignite Briquette Experiments.**—The Bureau of Mines, realizing the value of the vast deposits of lignite which exists in several western States, and particularly in North and South Dakota, Montana and Texas, recently obtained from Germany a powerful briquetting machine, which is being used to determine the suitability of American lignites for the manufacture of briquettes. The experimental work so far done has shown that lignite can be made into satisfactory briquettes at a cost that renders the manufacture commercially profitable. The extended use of lignite briquettes would serve as an important factor in the conservation of our supplies of coal.

**The Hell Gate Bridge.**—The letting of the contract for the imposing Hell Gate railroad bridge, which will serve to connect Long Island with the mainland at a point near the Harlem River, marks the beginning of work on the most imposing structure of its kind in this country, and the longest bridge of its type in existence. Its dominating feature will be a massive arch bridge of one thousand feet span, carrying four tracks capable of accommodating the heaviest railroad freight traffic. The total length of the bridge, including approaches, will be three miles. In the steel arch bridge alone there will be 18,000 tons of steel, and there will be a total of 70,000 tons in the whole structure.

**The Panama Canal Fortifications.**—With the exception of one of the fortifications at the Atlantic terminus, the defensive works which are being constructed at the Panama Canal will be named in honor of soldiers conspicuous in the Civil War. One of the Atlantic works will be called Fort De Lesseps. The sea-coast fort at the Pacific terminus will be known as Fort Grant, and its batteries will bear names of division commanders of the northern army. The sea-coast forts of the Atlantic terminus will be known as Fort Sherman, Fort Randolph, and Fort De Lesseps, and the batteries of Fort Sherman will be named after division commanders who served under General Sherman. The batteries of the other two forts will bear the names of artillery officers who distinguished themselves in the war.

**Improving the Port of Para.**—Although Para, the commercial metropolis of the Amazon valley and the greatest rubber-exporting center of the world, has long enjoyed an immense trade, this has been seriously hampered by two circumstances, viz., poor harbor facilities and the unhealthfulness of the town. Recently the Brazilian government has taken seriously in hand the improvement of the harbor, and has nearly completed works the total cost of which will amount to about $39,000,000. Whereas formerly large vessels, owing to the shallowness of the water, were obliged to lie some miles from the quays, a considerable part of the new quay wall will have a depth alongside of from 30 to 32½ feet. Docks, ship-railways, metallic warehouses, electric cranes, and buildings for the customs, postoffice and national telegraph are included among the improvements. Meanwhile the state of Para is endeavoring to improve the hygienic conditions of the city, and especially to eliminate the particular type of mosquito which is the carrier of yellow fever.

## Electricity

**Street Car Telephones.**—In order to avoid needless opening of car doors in winter weather, the street cars of Chicago are to be equipped with annunciator horns set at the four corners of the car in the ceiling, and connected with a telephone on the rear platform, by which the conductor may announce the streets.

**Wireless Messages to Filchner.**—According to *Petermanns Mitteilungen*, wireless communication is likely to be established between the Argentine wireless station on New Year Island (near Cape Horn) and the "Deutschland," the vessel of Lieut. Filchner's antarctic expedition, after the latter reaches the barrier ice and Weddell Sea.

**Wireless Lighthouse Signals.**—The new lighthouse at Ouessant, on the Channel coast of France, is noteworthy not only for its height of 120 feet and its powerful light, but also for the wireless signals which it is to send out. The new apparatus is designed to give vibratory wireless waves so as to produce musical signals in the well-known way. Two different notes, *do* and *sol* are used here, and they will be repeated at regular intervals so that such signals can be easily recognized by vessels at sea. Following this, other stations of the kind are to be erected along the Channel.

**Cairo-Heliopolis Electric Line.**—The new electric traction line running from Cairo to Heliopolis, Egypt, is laid out in two sections, the first lying between Boulac and Limoun Bridge and the second running from here to the second oasis. The line is built on narrow gage (3 feet 3 inches) and runs trains made up of motor cars. Each of the cars is fitted with four motors of the 50 horse-power Jeumont type, of French build, running on overhead trolley wire. For this latter the voltage varies between 500 and 700 volts according to the section of road.

**Limited Current for Small Consumers.**—The electric lighting station of Bremen, Germany, has adopted a method for the sale of current by which it hopes to reach small consumers and induce them to abandon oil lighting. For instance a workman's family living in a small lodging can make a yearly subscription for current to the amount of three 16 candle-power lamps per day, and for this he pays about the same price as for oil. He is entitled to the use of the lamps continually, but more than this number cannot be turned on, as a current-limiter prevents this. However, nothing prevents wiring the quarters for a larger number of lamps, provided not more than the stated number are turned on at a time.

**The Cost of Ultra-violet Sterilization of Waters.**—A report has recently been made by Grimm and Wedert on the cost of sterilizing water by means of ultra-violet rays produced in a quartz lamp. The cost for 50,000 hours' work was, for the quartz lamp $50, resistance $11, new burners $600, current $1,100, sundries $14, or a total of $1,775. This outlay represents the cost of sterilizing 5,000,000 gallons of water, or about one cent for 30 gallons. The cost of complete sterilization is relatively much greater than that of partial sterilization. By sterilizing the water within 99 per cent complete, the cost can be reduced to 90 gallons for one cent. As compared with this the ozone system of sterilization would cost half as much, and ordinary filtering one-tenth as much.

**Federal Electric Railroads in Switzerland.**—In Switzerland the question has been agitated for some time as to the best method to use for changing over the Federal railroads to electric traction, and a commission was appointed to look into the matter. The commission recently issued its report and in this it concludes in favor of electric locomotives running on the single-phase system with 15,000 volts on the overhead wire. Direct current is not favored, even though it takes less power, on account of the drawbacks it presents, first cost among others. It is estimated that the expense of transforming all the Federal lines will reach $15,000,000, but there will be 10 per cent economy realized in operating the railroads. The Swiss government has already allotted credits for purchasing a number of falls so as to erect electric plants for supplying the current.

**Electric Railroad from Genoa to Busalla.**—A successful electric railroad is now running in the north of Italy from Genoa to Busalla, under control of the government. Genoa sends coal to all the northern region including Milan and Turin. A steam railroad ran across the mountains for this purpose, but the new electric road will be much superior. It has heavy gradients and numerous tunnels, and uses heavy electric locomotives designed after the Simplon and Valtellina types. Current is taken from a 3,000-volt line, working on the three-phase system. The locomotives are designed to draw a 400-ton train upon 3.5 per cent grades at 25 miles an hour, and have 65 tons adhesion weight. The four axles of the locomotives are coupled by bar and crank and are driven from two 750 horse-power motors.

## Science

**Prehistoric Nursing Bottles.**—According to recent discoveries it appears that nursing bottles were used even in prehistoric times. This is true at least for the age of polished stone, inasmuch as a French archæologist, M. Nicaise, when exploring a neolithic funerary deposit, found a small clay nursing bottle, and this was quite intact. This is not the only specimen of the kind which comes from early ages. Among others are the specimens found in the Gaulish burial places of Jonchery and more recently in the Gallo-Roman arena of Paris. This latter, it will be remembered, was uncovered within a comparatively late period.

**The Genetic Congress.**—The Fourth International Genetic Congress, recently held at Paris, was occupied mainly with the crossing of breeds in plants and the resulting hybrids which are obtained. Outside of the great scientific interest which is involved, the question has a very practical bearing. For instance M. Soloman made experiments upon the crossing of potatoes for six years past, and hopes to produce a variety which will be able to resist the rotting disease. The question of hybrids in connection with many kinds of plants such as peas, tobacco, cloves and others formed the object of the papers read at the congress.

**A New Comet.**—A cablegram has been received at Harvard College Observatory from Prof. Kobold at Kiel, stating that a comet was discovered by Schaumasse, giving the following position:

1911. Nov. 30. 6991 Greenwich Mean Time, R.A. 13h. 12m. 12s., Dec. +5 deg. 51m.

Daily motion: R.A. 3m. 32s., Dec. —13m.

The comet is visible in a small telescope. A late cablegram from Kiel states that Schaumasse's comet was observed by Biesbroeck at Uccle in the following position:

1911. Dec. 4. 7482 Greenwich Mean Time, R.A. 13h. 26m. 25.7s. Dec. +4 deg. 57m. .05s.

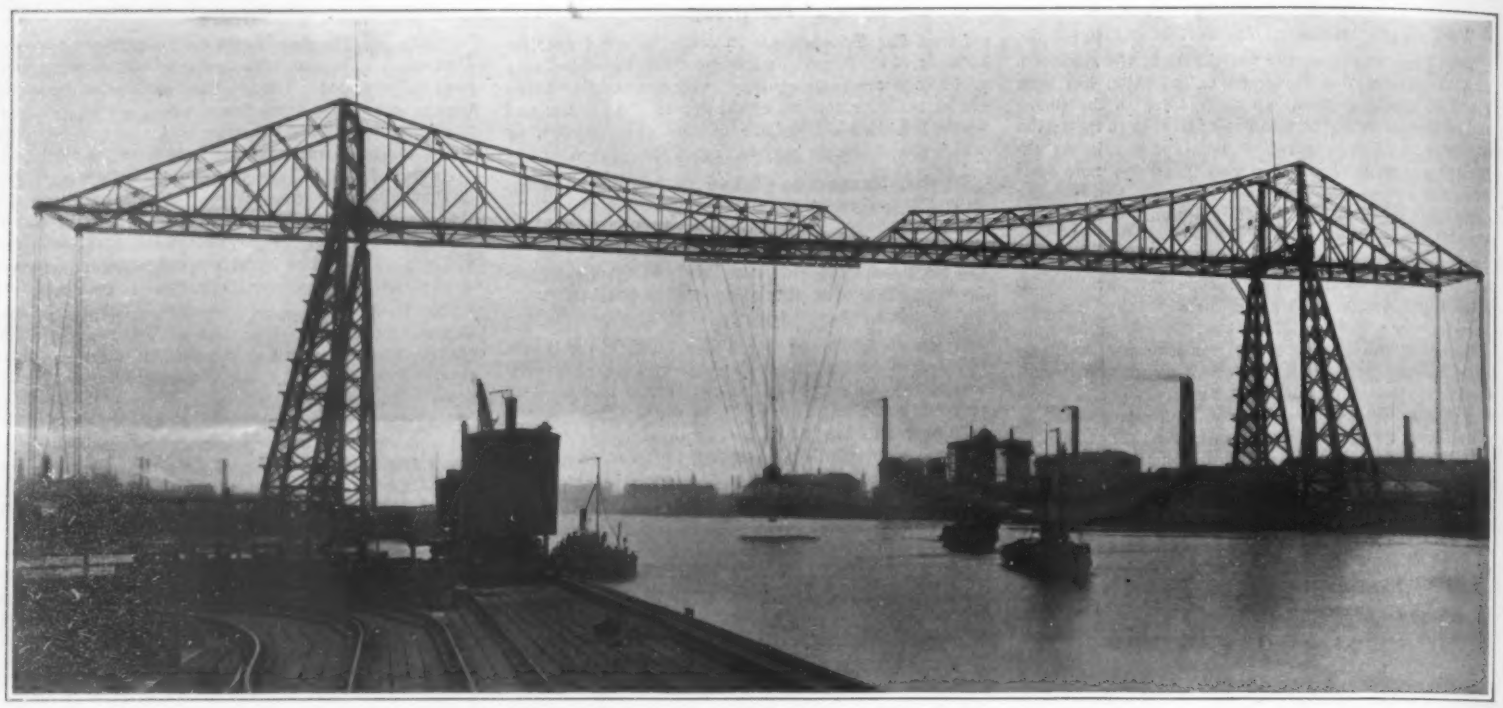
**Sterilized Post Holes.**—An engineer in Budapest has invented a process for the preservation of wood which bids fair to be of much economic importance. The process is intended to be applied to wood used in outdoor construction, such as railroad ties, telegraph poles, fences, palisades, and the like. It consists in a sterilization of the surrounding soil by means of a liquid poured into the hole in the earth before the post or tie is planted. The liquid is composed of chemicals which effectually destroy all insect life and all cryptogamous vegetation in the surrounding earth. According to *La Revue* this prevents the rotting of the wood without the necessity of treating it with creosote, so that both time and expense are saved in many cases.

**Conversing With Animals.**—A certain Charles Kellogg, of California, has appeared at Cambridge with the object of convincing the Harvard faculty of his ability to talk with animals. His life has been spent among the Sierra Nevadas, and his studies include the vocal sounds made by bears, squirrels, lizards, rattlesnakes, and crickets. Indeed, he claims proficiency in fifteen animal languages. He has a peculiar palate, with no tonsils, and entirely lacks the cord connecting the teeth with the lips. To these peculiarities he partly ascribes the ease with which he imitates the sounds of insects and animals. Some of his observations and ideas are at least interesting, if not convincing.

**Excavations at Delphi.**—The French School of Athens has been making some interesting excavations at Delphi, bearing upon four main points, the Temple of Hera, the valley and basin of the Inopos, the gymnasium and the theater quarter. More than 200 vases were found in the basement of the Temple, dating from the 7th to the 6th century B. C. Some blue ware of an unusual kind was found here, also a fine series of terra cotta busts of the goddess Hera. The plan of the gymnasium is now recognized, and some good stone inscriptions come from this spot. To the west of the basin which collects the water of the Ipsos torrent are the ruins of a small sanctuary which appear to date from the early history of Delphi.

**The Weight of Various Brains.**—While the weight of the individual brain in each particular species, as compared with that of the entire system, may be said to have some bearing on the intelligence of the individual, there is no fixed proportion between the weight of the brain and the total weight of the body, as between one species and another, as is shown by the following table:

| | Grammes. | Average Ounces. | Proportion. | Per Cent. |
|---|---|---|---|---|
| Elephant | 4,660 | 16.44 | 1/439 | 0.23 |
| Whale | 2,490 | 8.78 | 1/25000 | 0.04 |
| Man | 1,400 | 4.94 | 1/42 | 2.38 |
| Horse | 500 | 1.76 | 1/534 | 0.19 |
| Gorilla | 425 | 1.50 | 1/213 | 0.47 |
| Orang outang | 400 | 1.41 | 1/134 | 0.75 |
| Sheep | 133 | 0.47 | 1/377 | 0.27 |
| Dog | 105 | 0.37 | 1/200 | 0.50 |
| Pigeon | | | 1/150 | 0.67 |



The suspended passenger car traveling across the River Tees.

# Novel Transportation Bridge in Great Britain

## A Suspended Ferry

By F. C. Coleman

A NEW transporter bridge, which has been under construction for the past three years over the River Tees, one of the great industrial waterways of North-Eastern England, was formally opened for traffic by H. R. H. Prince Arthur of Connaught on October 17th. Hitherto communication between the thriving town of Middlesbrough and the industrial area on the north side of the river has been maintained by means of a municipal ferryboat service, but, during recent years, this method of transport has proved both inadequate and inconvenient. Consideration has been given at various times to projects for a tunnel under the river, a suspension bridge, an ordinary swing bridge and also a rolling lift bridge. In the case of a busy river like the Tees, it is essential that any means adopted for accommodating the cross traffic should interfere as little as possible with the conduct of the up-and-down stream traffic, and if no other objections existed there would be no doubt but that a tunnel or high-level bridge would have afforded the best means for attaining this end. But both the tunnel and the high-level bridge, independently of high cost, would have involved the difficulties of approaches and in the case of a high-level bridge, this would, in a flat district like that of Middlesbrough, form a practically insurmountable obstacle, so long as the bridge was utilized by the traffic passing over it in the ordinary way. Accordingly, in 1906, the Middlesbrough Corporation decided to replace the ferries by a transporter bridge.

Passenger car approaching the Middlesbrough side.

The Tees transporter bridge consists of two groups of piers erected on either bank of the river on masonry foundations and connected by a pair of lattice-type girders of 570 feet span with depths varying from 65 feet over the towers to 21 feet at the centers. The underside of these girders is 160 feet above high-water mark. The girders on the lower flange each carry two lines of rails and are placed at a distance of 35 feet from center to center. On the four lines of rails there is supported a traveling platform from which a traveling car, 44 feet by 39 feet, is suspended. This car is provided with passenger cabins on each side, and its floor is level with the roadway on each side of the river. Accommodation will be found for about 600 passengers and six road vehicles. As the upper platform travels across the high-level girders the car is carried across the river between the landing places, the hauling to and fro of the traveling platform being effected by an endless ropeway. The ends of this rope are fixed on a winch placed on the south side of the river and driven by two 60 H. P. Westinghouse motors. The journey from shore to shore will be accomplished in less than two minutes. The working of the car will, generally be controlled from the pilot house placed on the top of the passenger cabin on the suspended platform, but in case of emergency it can also be worked from the winch house, distant about 150 feet from the main tower of the bridge on the Middlesbrough side of the river. One motor will, it is anticipated, be more than sufficient to propel the car, even in the most severe gale.

The main girders are of the braced cantilever type and the extremities of the main span are anchored and secured to concrete anchorage blocks on each bank of the river by 16 wire ropes embedded in concrete, each rope being capable of withstanding a breaking strain of 300 tons. Owing to the unfavorable strata the main towers on the Port Clarence side have been distanced 130 feet from the shore and approach is therefore made by a lattice girder bridge. On the Port Clarence side the foundations were carried down to 90 feet below high water of spring tide, and on the Middlesbrough side to a depth of 70 feet. The caisson foundations are filled up solidly with concrete, and 10,000 cubic yards of concrete were used in these foundations and in the retaining walls supporting the same. After the caissons had been sunk and the steel towers sunk, the erection of the main girders proceeded simultaneously toward the land arm and over the river on the cantilever system. As the steel arms from each side of the river approached one another careful measurements as to levels and line had to be taken from time to time so as to insure an exact meeting in the center. As soon as they were within 100 feet of one another, exact dimensions were taken and after due allowance had been made for the proper measurements the closing lengths of the steel work that were required to fill in the gap were completed at the contractors' works and forwarded to the site. Aided by favorable weather conditions, the 100 feet of closing lengths was erected in position in sixteen hours, the work coming together perfectly as to line and level. The temperature at the time of closing was 53 deg. Fahr. The height of the towers above high water is about 250 feet, so that the bulk of this work was carried out at a height of about 200 feet.

Spiral stairways on one of the two towers of each abutment afford access to the main platform of the bridge and this passageway is specially illustrated in one of the photographs. The total length of the bridge and approach span is 850 feet, the length of each cantilever girder overhanging on the landward side of the towers is 140 feet, and the extreme height of the bridge above high water to the top of the center of the towers (i. e., to the top of the main posts of the cantilever girders) is 225 feet. The base girders, on which the towers are built, have a length of 98 feet, a depth of 16 feet, and a weight of 163 tons. The total amount of steelwork in the bridge is 2,600 tons and there are 600 tons of steelwork in the caisson foundations. The total cost of the works and approaches, including buildings and all auxiliary work in connection with the structure, is estimated to be about $408,660.

**The boulevard across the main girder of the bridge, reached by spiral stairways in the towers.**

### The Rabbit Problem in Australia

RABBITS are well known to be the curse of Australia; notwithstanding the fact that, according to the view of the commonwealth meterorologist, Mr. H. A. Hunt, the burrows of these animals, by keeping the ground broken up, make it more retentive of rainfall—a philosophical consideration that strongly suggests Mark Tapley. Latterly, the Australians have been trying with considerable success to turn their curse into a blessing by marketing their surplus rabbits (dressed) in European countries.

# The Most Powerful European Express Engine

## An Important French Locomotive Development

THE Chemin de Fer du Nord has recently introduced into service, huge "Baltic" type, four-cylinder compound superheater locomotives for operating the Nord Express, connecting Paris with Brussels, Berlin, the Baltic seaboard and St. Petersburg. This international express service ranks as the fastest train service in the world, and, with 400 tons coach load, the French engine attains 75 miles per hour, developing in the cylinders about 2,000 horse-power.

Two engines of the "Baltic" wheel arrangement have been built by the Chemin de Fer du Nord for comparative working, the only difference being that the first engine, 3.1101, is fitted with ordinary locomotive firebox and boiler, while the later engine, 3.1102, has a marine pattern water-tube firebox. This firebox was designed by the Nord company's engineers, although actually constructed at the Creusot Works of the Schneider Company. Both engines are fitted with apparatus for highly-superheated steam, and the cylinders in each engine are identical. Instead of constructing the ordinary type boiler for saturated steam and placing a water-tube boiler for superheated steam over a simple engine, the same system of compounding is here employed in both engines.

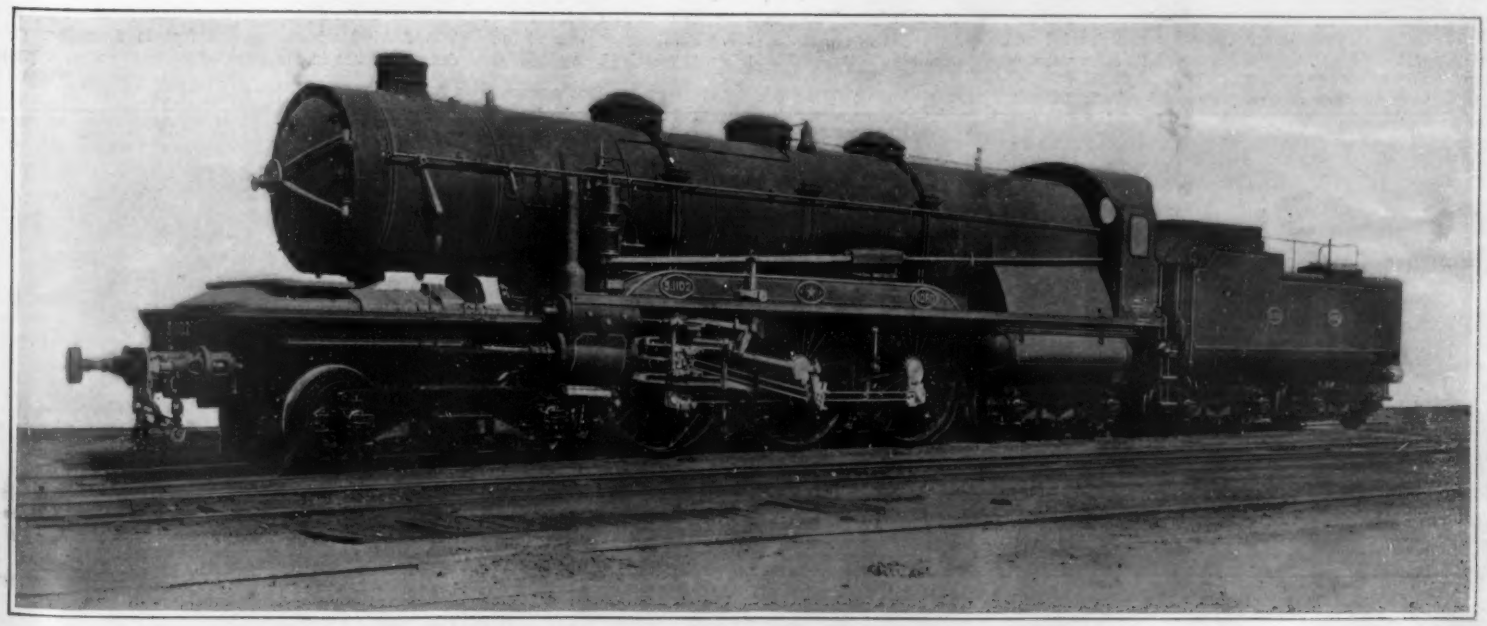
The previous largest engines in Europe are the "Pacific" type, class 10, of the Belgian State Railways, which have four cylinders, each 500 millimeters by 660 millimeters (19.68 x 25.98 inches). The new Nord engines have, however, two high-pressure cylinders, 440 millimeters (17.32 inches) by 640 millimeters (25.19 inches) and two low-pressure cylinders 620 millimeters (24.41 inches) by 730 millimeters (28.74 inches). Further, while the steam pressure in the Belgian engines is 200 pounds per square inch, the French engines carry a pressure of 227.5 pounds per square inch with direct admission from the boiler to all the cylinders whenever it is found desirable for starting.

These French engines, although very much more powerful in starting effort than the Belgian locomotives, are of the same weight, loaded and empty, as the latter, but the boilers of the Nord engines have 23 per cent more heating surface.

The chief interest in these new locomotives is the novel solution of the cylinder problem, which has, for years past, been an obstacle in the design of very powerful locomotives, the difficulty occurring when specially large cylinders are necessary, either for low-pressure saturated steam, superheated steam, or extra low pressures in one-half of a compound engine. The high-pressure cylinders are mounted outside the frames and drive on the center pair of the three sets of coupled wheels with cranks set at 90 degrees apart. The low-pressure cylinders are inside the frames and drive on the forward pair of coupled cylinders. The cranks in this case are also set at right angles to one another and each high-pressure is at 180 degrees from its corresponding low-pressure crank. One of the low-pressure cylinders is set in advance of the other, so as to get the centers of the piston rods close together. Although intended for cylinders working at 80 pounds maximum pressure, this device is applicable to any system of engine with such modification as may be desirable. The driving wheels have a diameter of 6 feet 8¼ inches and the bogie wheels a diameter of 3 feet 4½ inches. The firebox grate is 8.56 feet in length and 5.3 feet in width and the grate area is 46 square feet. The total heating surface amounts to 4,394.93 square feet, to which the water-tubes and firebox contribute 1,097.95 square feet, and the smoke tubes 2,629.6 square feet, while the superheater surface is 667.38 square feet. The boiler barrel has a diameter of 6 feet 2¾ inches. The water capacity is 1,886 gallons, and the steam capacity 690.8 gallons. The tractive force of these locomotives working compound, is 32,429 pounds, and simple 42,834 pounds.

An interesting innovation is the adoption of mechanical stokers. On the Northern Railway the express engines are served with "smalls" and "tout-venant" which, to avoid choking the fire and evolving heavy smoke, must be laid on thinly and with great frequency. Opening the fire-door frequently is injurious to the tube plate and tends to lower the temperature of the steam in the superheating pipes. With mechanical stokers these and other objections disappear, the fuel in fine powdery form may be blown into the fire-box with suitable tuyères.

In running order, the engine weighs 102 tons, of which 24 tons is on the leading bogie, 54 tons on the coupled wheels and 24 tons on the trailing bogie. The tender is of the standard Nord 8-wheels type and weighs 56½ tons, so that in working order these "Baltic" locomotives have a total weight on rails of 158½ tons.



**Baltic type four-cylinder compound superheater locomotive for the "Nord Express."**

# Some Locomotive Curiosities

## Showing How Present Practice Was Reached by Trial and Error

By Herbert T. Walker

IT is only within recent years that the locomotive has been studied by scientific men on systematic principles, with the aid of elaborate testing plants and other special apparatus.

The early designers of locomotives were not scientific men in the strict sense of the term. They were mechanics who studied science in their leisure moments, and were not always well grounded in principles. They were, moreover, hampered with ideas of stationary engine practice, for the earliest locomotives were but little more than stationary engines on wheels. Even the rails were laid on stone blocks after the manner of stationary engine foundations.

Thus, the attempt to adapt a low speed stationary engine to a fast locomotive produced many curious and interesting examples.

Drawings of many of these are in the writer's possession, and engravings of ten of them are here presented with a brief description.

A fruitful source of trouble to the old locomotive designers was a tendency to follow the teachings of James Watt, who had laid down a fixed rule that the piston speed of a steam engine should not exceed 220 feet per minute. The only way, then, to build a high-speed locomotive was to employ large driving wheels. The culmination of this theory is found in engines built for the Great Western Railway (England) which originally had a track gage of 7 feet. The engineer of this railroad was I. K. Brunel, who, although he was the greatest civil engineer who ever lived, fell into the same error as his contemporaries. He wanted the fastest locomotives in the world, and when ordering them of various builders he limited the piston velocity, with the result that when the railroad was opened for traffic (June 4th, 1838) the motive power superintendent, Daniel Gooch, was confronted by a collection of engines which made the roundhouse look more like a museum of curiosities than anything else.

Two of the engines are illustrated herewith. Fig. 9 shows the "Ajax," the driving wheels of which were 10 feet in diameter. Cylinders 14 inches diameter by 20 inches stroke. Total heating surface, 474 square feet. The wheels were built up of boiler plates. A drawing of this engine was first published in the *Locomotive Magazine* (London) of 1901 by Mr. G. F. Bird in his "History of the Great Western Railway Locomotives," and by the courtesy of the editors of that journal a reproduction is here given.

The other 10-foot driver engine was a fearful and wonderful machine, for the engine and boiler were on separate frames, as shown in Fig. 2. The object of this arrangement was to distribute the weight, as the rails of that period were very light. The engine had a tender (not shown) behind the boiler where the fireman attended to his duties, but the engine driver was stationed on a platform forward of the driving axle, without any shelter from the weather. The cylinders of this monstrosity were 16 inches diameter by 20 inches stroke. Total heating surface, 623.42 square feet. The weight of the engine carriage was 13 tons, of which only about 6 tons were available for adhesion, so that with the absurdly small cylinders the engine was almost useless for practical work, although it would go fast enough with a light train. In fact it was reported that both this engine and the "Ajax" attained a speed of 100 miles an hour when running without a train, but this is very doubtful.

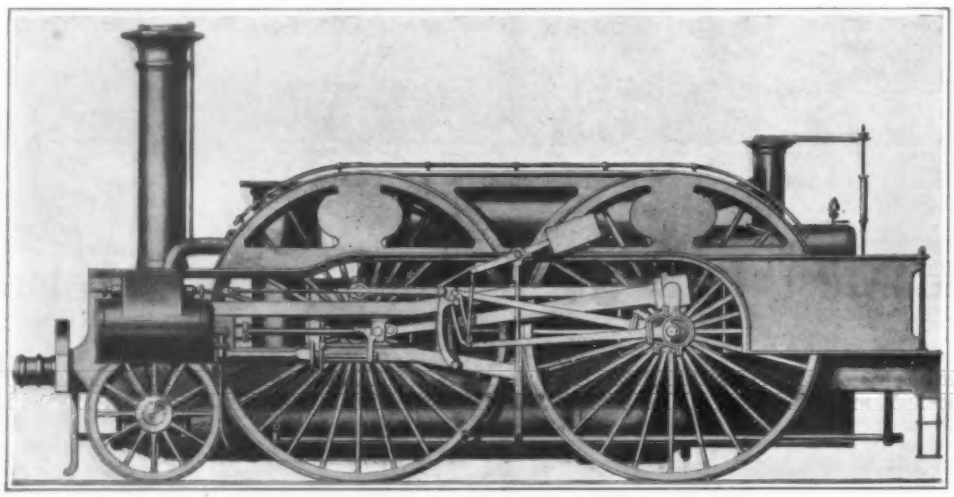


Fig. 1.—"L'Aigle." Western Railway of France, 1855. 9 feet 4 inches coupled wheels. Boiler below the driving axles.

Other and more practical engines were built with large wheels, as for example the "Cornwall," designed by Francis Trevithick in 1847. This engine is illustrated in Fig. 4. It did good service on the London and North-Western Railway. The boiler was slung below the driving axle, as a high boiler was considered unsafe for fast running. The "Cornwall" was like a rare animal and attracted much attention, as it was considerably lower than the cars of its train. The driving wheels were 8 feet 6 inches in diameter. Cylinders 17½ inches diameter by 24 inches stroke. Total heating surface, 1,046 square feet. Weight, 30 tons. A speed of 117 miles an hour was claimed for this engine, but this is not credited by engineers. Under official tests it attained a speed of 79 miles an hour with a light train. Full particulars of this engine were published in the SCIENTIFIC AMERICAN of June 10th, 1905.

The "Lightning," an American engine with large drivers, is shown in Fig. 3. This engine was of the "Crampton" type, the driving wheels being placed behind the fire-box. It was built at the Norris locomotive works in 1849 for the Utica and Schenectady Railroad. The cylinders were 16 inches in diameter by 22 inches stroke. Driving wheel 7 feet in diameter. As the heating surface of the boiler amounted to only 678 square feet, it was a poor steamer. Nevertheless it attained a speed of 72 miles an hour for a short distance with a light train. This engine weighed about 20 tons and was in service a little over one year.

The last example of a large wheel engine is shown in Fig. 1. It had the largest coupled wheels ever used, namely, 9 feet 4 inches. It was designed by Blavier and Larpent for the Western Railway of France in 1855, and was exhibited at the Paris Exhibition of that year. The name of this engine was "l'Aigle." The cylinders were 16½ inches in diameter by 31½ inches stroke. The boiler was below the driving axles as in the "Cornwall," but was so short of heating surface that the engine never did any useful work. To show that nothing is gained by excessively large wheels, we may point out that an engine with cylinders of the same diameter as that of "l'Aigle" and a stroke of 22 inches, with 6½ feet driving wheels would have given the same tractive effort with the same mean pressure of steam; and with this observation we may dismiss the subject of large driving wheels.

There was a still more interesting class of early engines which were called "compensated locomotives." They were the earliest balanced engines, and show some original attempts to overcome the erratic movements of a locomotive when traveling at speed without driving wheel counterweights. The oldest of these engines is shown in Fig. 10. It was built in 1833, and worked on a short road running between Bolton and Kenyon Junction, now forming part of the London and North-Western Railway. No dimensions of the engine are available, but the driving wheels scale a diameter of 5 feet. The equilibration of the reciprocating masses can be easily understood, for the oppositely moving parts connected to the vibrating arm or "side lever" partially balanced each other, although with the vertical boiler and high pitched cylinders the engine was probably an unsteady rider, if it ever went fast—which is doubtful.

The most important side lever locomotive ever built is illustrated in Fig. 7. It was designed by the celebrated Crampton in 1847 and patented by him. The driving wheels were 6 feet in diameter. Cylinders 16 inches in diameter by 20 inches stroke. Weight

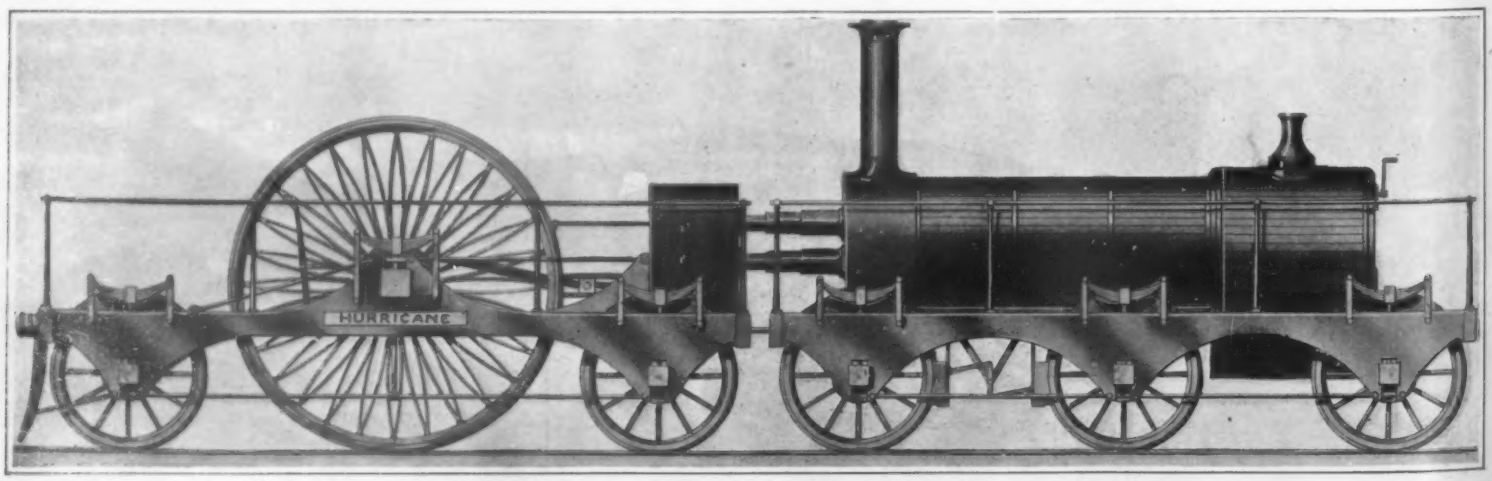



Fig. 2.—The "Hurricane." Great Western Railway, 1838. 10-foot driving wheels. Boiler and engine on separate frames.

35 tons. Total heating surface 1,271 square feet. This engine was named "Lablache," after a noted operatic singer of the day. Details of its performance cannot be given here, but we may note that the engine was officially timed at 79 miles an hour with a light train. On one occasion the "Lablache" hauled a freight train of 430 long tons at an average speed of 30 miles an hour, which was no mean performance at that period. The peculiarity of this engine was that the cylinders inside the frames actuated vibrating arms connected to the outside levers called the "side levers." These side levers were coupled to the cranks in such a way that when the front driving wheel crank was, for example, on the back center the rear crank was on the front center, and thus the stresses of these oppositely moving parts were balanced. Moreover, the cylinders, guides and vibrating beam fulcrums were all bolted rigidly to the frame and therefore not subject to the effects of crosshead vertical thrust, as in the ordinary locomotive. The "Lablache" was tried on the Midland and other railways in England, but no company would purchase it on account of its great weight, and it was in use only a short time.

Another curious locomotive was built in 1856 in which the "Lablache" arrangement of cranks was repeated, but the cylinders had double pistons and a separate rod for each crank. This design was patented in England by Charles Ritchie in 1848, but he did not build an engine until eight years later. This engine is shown in Fig. 5. As the two pistons in each cylinder always moved in opposite directions the fore and aft stresses set up by the reciprocating parts were neutralized, for the momentum of one piston and its connections was balanced by that of the other. This engine weighed about 25 tons. The wheels were 6 feet in diameter. Cylinders 12 inches diameter by 36 inches stroke, each piston having a stroke of 18 inches. Supposing the engine to be in the position shown in the drawing and steam admitted to the center of the cylinder, the pistons would be driven apart and the engine would travel forward. As coupling rods could not be used Ritchie designed a parallel motion, the two sets of which

(Continued on page 566.)

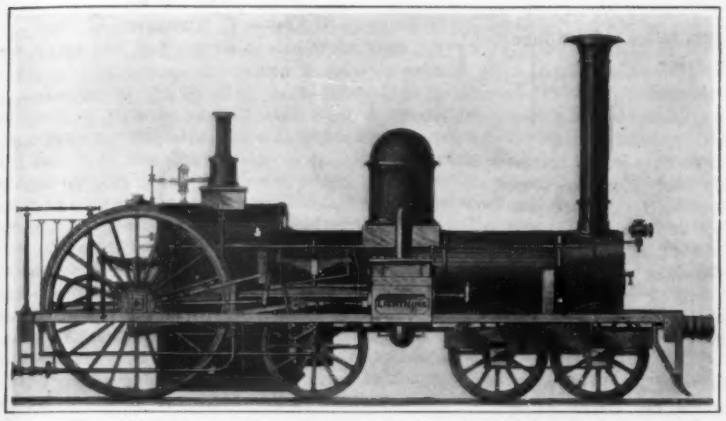


Fig 3.—The "Lightning," 1849. Utica and Schenectady Railroad. 7-foot driving wheels.

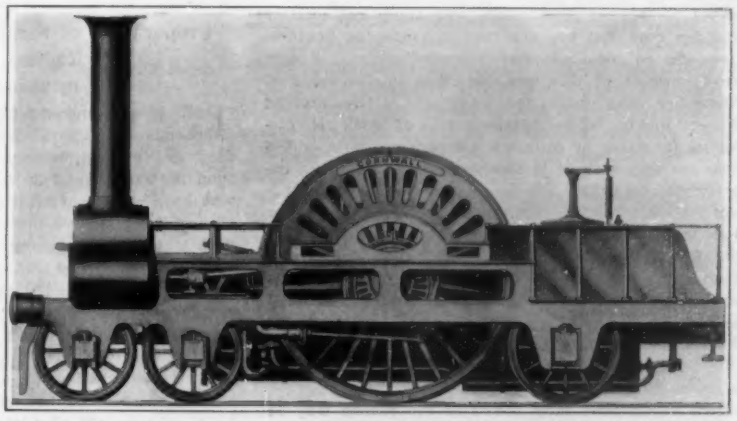


Fig. 4.—The "Cornwall," 1847. London and North-Western Railway. Boiler below the driving axle.

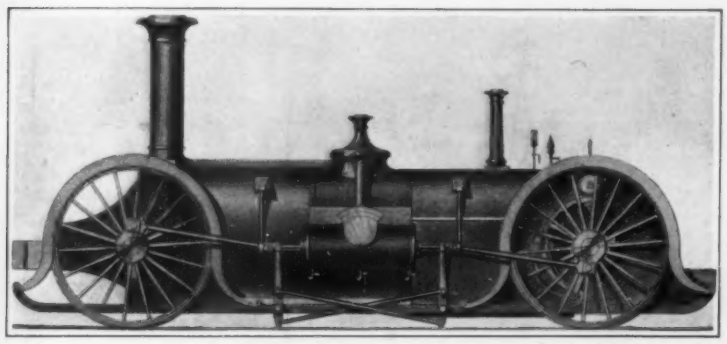


Fig. 5.—Ritchie's double piston balanced engine, 1856.

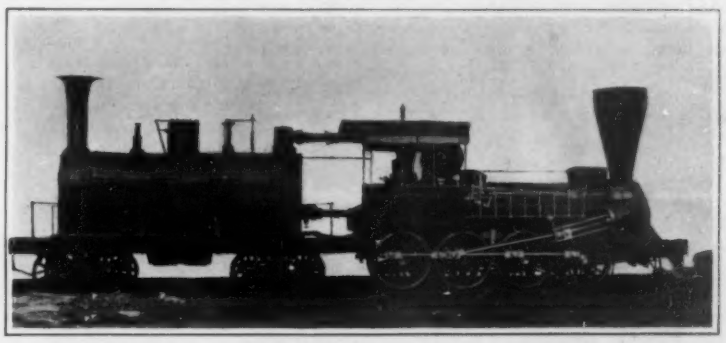


Fig. 6.—The "Noveity," 1847. Philadelphia and Reading Railroad. Boiler and engine on separate frames.

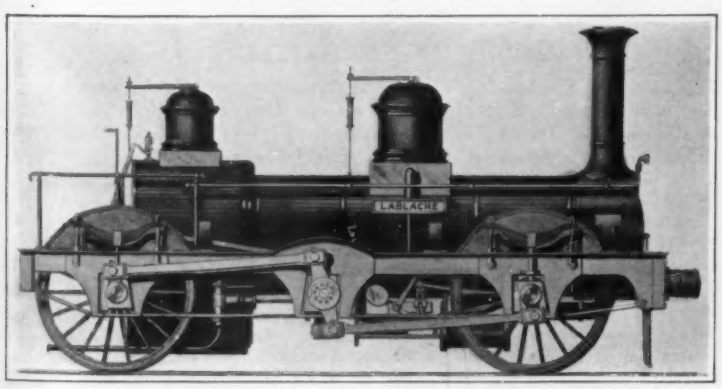



Fig. 7.—The "Lablache," a Crampton side lever engine, 1847.

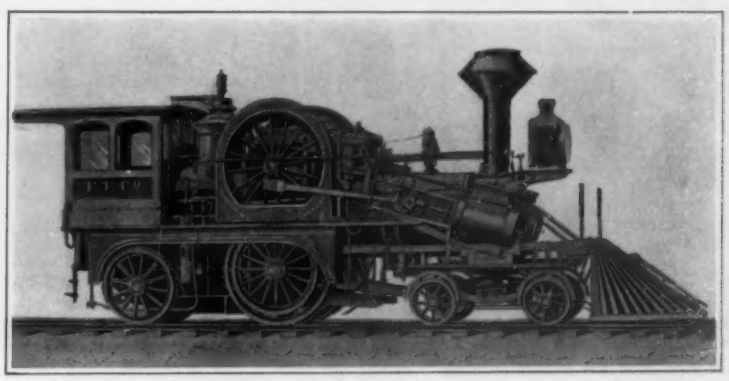


Fig. 8. The "Fontaine," Canada Southern Railway. A geared engine, 1887.

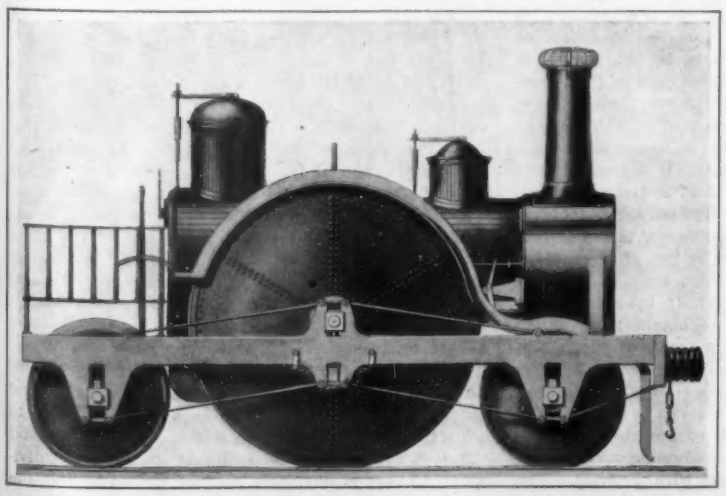


Fig. 9.—The "Ajax," Great Western Railway, 1838. 10-foot driving wheels.

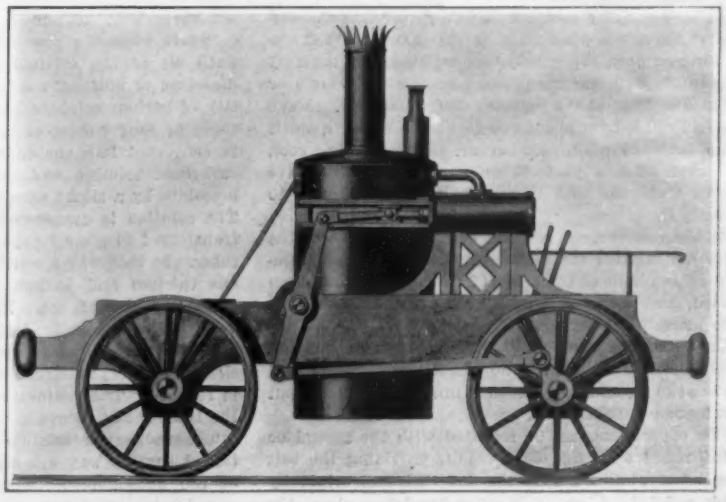


Fig. 10. Side lever locomotive. Bolton and Kenyon Junction Railway, 1833.

SOME LOCOMOTIVE CURIOSITIES

# The Laboratory

## Some Suggestions for Home Experiment

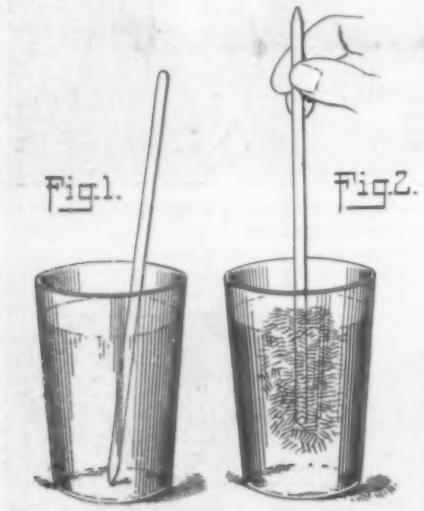
### Experiments in Crystallization

By A. J. Jarman

DURING the process of crystallization of many chemical salts, some unusually peculiar phenomena occur. It is well known that if a saturated or supersaturated solution of almost any salt is allowed to stand undisturbed for some time, many hours and sometimes days will elapse before crystallization will commence. While if the vessel is disturbed, or the liquid stirred crystallization will start immediately and the heat that was absorbed in producing liquification, will be given out during crystallization. A very good example of this was described in the issue of November 4th, under the heading "A Heat-Storing Water Bag." When hyposulphite of soda is dissolved in water at ordinary temperature a considerable quantity of heat is absorbed as the following experiment will show. The temperature of the surrounding air was 70 deg. Fahr. Ten fluid ounces of water was taken and placed in a clean wide-mouth bottle, the temperature of the water being 60 deg. Fahr. Twelve ounces of *granulated* hyposulphite of soda was added to the water, and stirred with a glass rod until nearly dissolved. Upon inserting the thermometer the temperature fell from 60 to 30 deg. Fahr. and in the course of about one minute the temperature had fallen to 29 degrees.

This experiment fully indicates the reason why in photography warm water must be used in the winter time in mixing the fixing solution, either for paper prints or plates, otherwise the time for fixing would be prolonged for a considerable period, and cause patchiness, in color, as well as an irregular fixed print.

Another interesting experiment is as follows: Prepare a supersaturated solution of sulphate of soda




**Crystallization started with unsterilized glass rod.**

(this usually requires two ounces of the salt to one ounce of water). Heat two or three small glass tumblers and pour the supersaturated solution into each. Cover the top of each vessel with a piece of sheet glass, and let the tumblers stand undisturbed until they have become quite cold. It is well to prepare the vessels at night, allowing them to stand undisturbed until the morning. They will then be ready for the next step in the experiment. Take a glass rod, about 9 or 10 inches long and a quarter inch diameter. Make one end red hot for about two inches, in either a spirit lamp flame, or a Bunsen burner. Suspend it to cool, and then stick a piece of gummed paper about five inches from the end that was heated, in order to identify it.

As soon as the rod is quite cold, remove one of the glass plates from the vessel containing the cold solution of sulphate of soda, insert the end that has been heated, and stir the liquid. No crystallization will take place.

Turn the rod around, insert the end that has not been heated and stir the liquid. Crystallization will begin at once, and will continue until the liquified salt has become a solid mass.

The experiment can be repeated with the second or third vessel with the same result, providing the salt has not crystallized upon the end that was originally made red hot. If crystallization has taken place, the end must be well washed by pouring warm water over it. This peculiar property has been known in some instances to be retained by the glass rod for two weeks, when not touched, and kept from the atmosphere. The experiment is not a costly one. Hyposulphite of soda can be purchased at almost any drug store for five cents a pound, and sulphate of soda at about the same price. The illustration in Fig. 1 shows the stirring without causing crystallizing; Fig. 2 shows the growth of crystals from the rod in the center of the saline solution.

### Preparation of Small Quantities of Impure Radium Bromide

By James H. Doran

THE idea is undoubtedly held among most amateur chemists and physicists that experiments with radium are inaccessible to those who have only a limited fund for experimenting in this line. However, those who have a fair chemical equipment can prepare samples of fairly active material with little trouble and with which a great many interesting experiments can be performed. The radium in these samples is of course infinitesimal, but asserts its presence by ionizing gases and discharging electroscopes, and by blackening photographic plates through paper and sheets of wood and thin metal.

In the separation of active material from pitchblende, samples of the ore which are known to be high in uranium should be taken as these always yield the most active substances. The ore is first reduced to a powder and roasted in a crucible for about 45 minutes and after cooling, pulverized to a fine powder. It is then mixed with about twice its weight of sodium carbonate and a little sodium nitrate and the mixture is again heated for nearly an hour. It is then extracted with water, and filtered and washed until all soluble parts are washed away. The insoluble portion is treated with a mixture of three parts C. P. sulphuric acid and one part C. P. nitric acid and this diluted with an equal amount of water. The acid should be added until effervescence ceases and until no more ore apparently goes into solution. The solution is then allowed to stand with occasional stirring for at least 24 hours. The insoluble part is allowed to settle and the acid solution decanted. If desired, this solution may be used for separation of the uranium contained in it. After decanting, the residue is thoroughly washed and treated in the same manner with an equal mixture of C. P. hydrochloric acid and water. This mixture which contains the polonium and actinium is then decanted and the residue washed and boiled with a saturated solution of sodium carbonate so as to change the still insoluble sulphates into carbonates. The sodium carbonate solution is drawn off and the residue washed and digested with pure hydrochloric acid diluted with a little water. This solution contains the active material which has now gone into solution. It is filtered and a slight excess of ammonia is added to the filtrate. Then it is again filtered and hydrogen sulphide gas is led into the clear solution until no more precipitation occurs. After filtering, sodium carbonate is added to the filtrate and the precipitate thus formed is thoroughly washed. Several grains of this mixture of active carbonates should be obtained from each ounce of ore.

Enough dilute hydrobromic acid is added to dissolve the carbonates and the solution is filtered. C. P. sulphuric acid is added until the precipitation is complete when the precipitate is washed by decanting until all of the calcium sulphate in the sample is dissolved or until only a few grains remain (the quantity of barium sulphate being often very small if only three or four ounces of ore are used). This residue is converted into carbonates by boiling with sodium carbonate solution and this again is converted into bromides by a slight excess of C. P. hydrobromic acid. The solution is evaporated to dryness and is quickly transferred to glass stoppered bottles or is sealed into tubes. In this way a centigram or two of the radiferous calcium and barium bromides may be obtained from a pound of ore. However, if the quantity is very large and it is desired to obtain more active material this may be done by a series of crystallizations and recrystallizations until the desired activity is reached. The radium bromide is less soluble than the barium salt, hence it crystallizes more quickly.

The radiferous calcium and barium bromides obtained in this way are often self-luminous, the color of the phosphorescence varying with activity. The samples lose their phosphorescence if allowed to accumulate moisture but recover it again on being dried.

If the samples are very active they will produce fluorescence in barium platinum cyanide and show the scintillations of the $\alpha$ rays when held close to a zinc sulphide screen and observed through a magnifying glass. Good radiographs can be taken in a few hours' time with a few grains of the impure RaBr$_2$ prepared in this manner, X-ray plates being the best to use for this purpose.

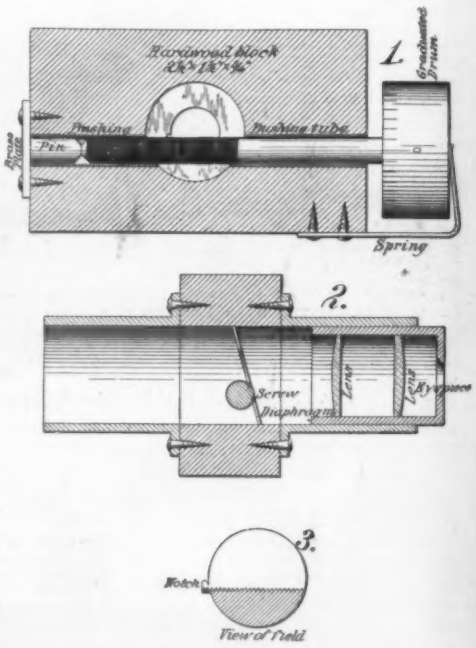
### A Simple Micrometer

By Claude C. Kiplinger

THE instrument here described has been in use for some time on a home-made spectrometer and has given good satisfaction. Although it is not intended to replace a first class filar micrometer, its simple construction renders it a desirable piece of apparatus.

As in nearly all devices of this sort, the most important part is the screw. A metal rod, preferably of brass, 2½ inches long and three-sixteenths inch in diameter is threaded at one end for two inches of its length with either fifty or one hundred threads to the inch, according to the sensitiveness desired. A metal drum, with its perimeter divided into twenty equal parts by a scale, is soldered to the unthreaded end of the rod, as shown in Fig. 1. This completes the moveable part of the apparatus.

A block of hard wood should be squared up to the dimensions shown in the sketch. A three-quarter-inch




**A micrometer of simple type.**

hole is bored through the flat side of the block, at its middle point, and a four-sixteenth-inch hole is drilled from end to end intersecting the former, as illustrated. The latter hole should be bushed at each end with brass tubes, in which the threaded rod turns easily, but without play. A metal plate covers one end of the hole and a closely fitting steel pin is inserted, of such a length that the threaded rod having been introduced, the drum will be stopped about one-fourth of an inch from the end of the block. A spring presses on the drum and holds the screw firmly against the pin.

A sheet metal diaphragm with a three-eighths inch aperture is fitted in a slanting position, shown in Fig. 2, so that its upper part will fall into the same focal plane as the top of the screw. A notch is cut at one side of the aperture to serve as a reference point (see Fig. 3). Brass lens tubes are attached by means of flanges and wood screws. The inside of the tubes and the diaphragm should be blackened. A positive eye-piece of one-inch focus is used. However, a single convex lens of the same focus may be substituted.

After assembling the instrument, the eye-piece should be focused sharply on the top of the screw. The field will now appear traversed by a series of notches, as in Fig. 3. When the drum is turned through a complete rotation, each notch is seen to shift its position by its own width. Hence, fractional parts of a notch will be indicated by the drum divisions. There is obviously no lost motion and if the threads are accurately and sharply cut very precise measurements may be made. This micrometer may also be used with a microscope.

# The Inventor's Department

## Simple Patent Law; Patent Office News; Inventions New and Interesting

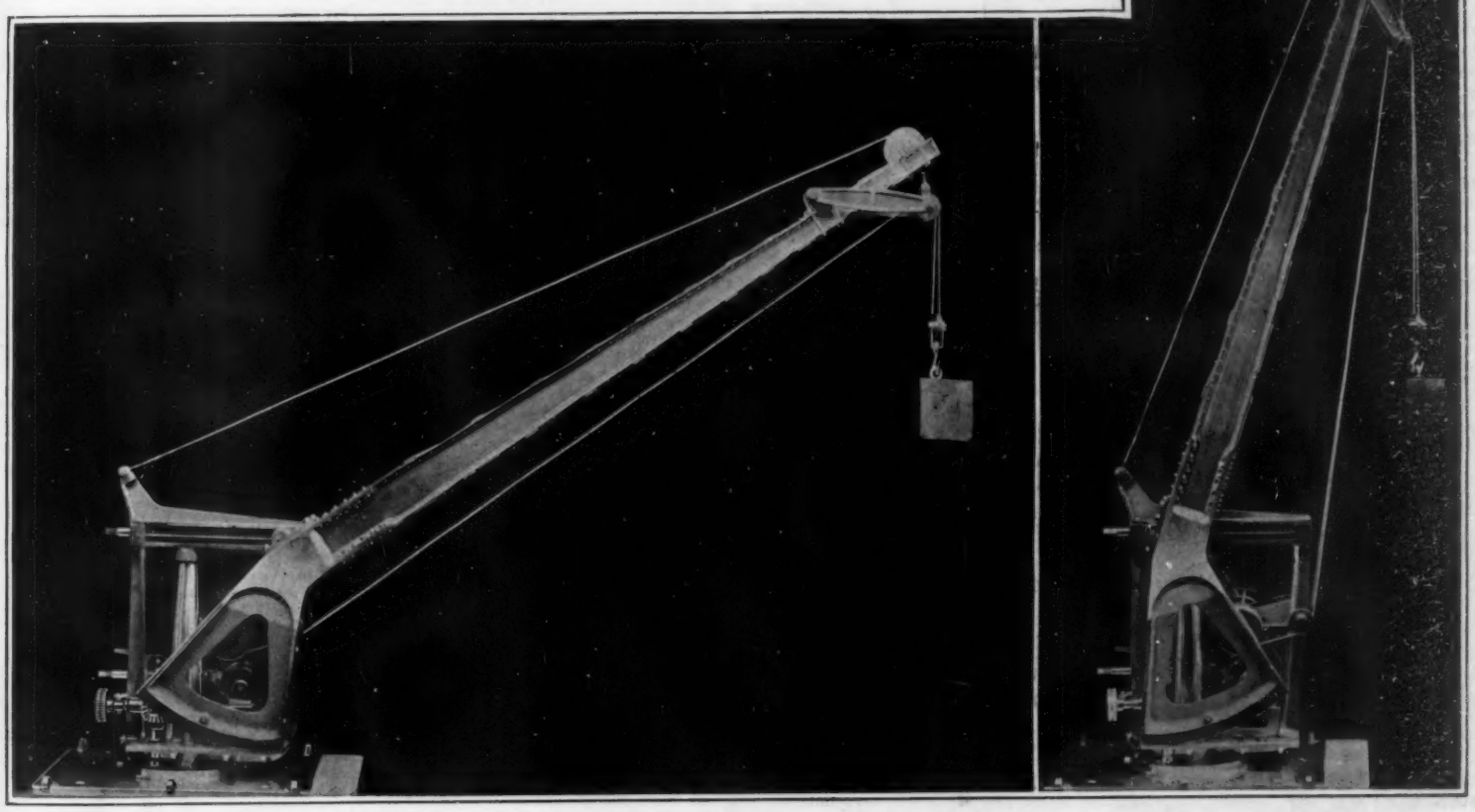
### Compensating Quadrant Crane

THERE is a certain type of machine now in common use that has been handed down to us, with little change, from the very earliest days of history. The crane as employed by the Egyptians in building the Pyramids was not radically different from the derrick of the present day. It consisted then, as it does now, essentially of an upright mast with a boom or gaff. Practically the only advances made in this type of machinery have been in the manipulation of the crane or the motive power utilized. Recently, a patent has been granted on a crane which is a decided innovation. The crane has no mast, but consists merely of a beam mounted on a frame in such a way that it can swing forward like the boom of a derrick while the load it carries moves on a virtually horizontal line as the beam is raised to the vertical position.

The beam is built up of rolled steel and is secured to a pair of quadrants of cast steel formed with teeth, to engage racks at the foot of the frame. The frame is mounted on a swivel base. The beam is raised or lowered by means of a horizontal screw which passes through a nut journaled to the quadrants. As the screw is operated, the quadrants roll on the toothed foot of the frame. Hence, the fulcrum, which is the point of contact of the quadrant with the frame, moves outward as the beam moves toward the horizontal and at the same time the length of the lever from load to fulcrum is reduced, owing to the bell-crank form of the beam and quadrants.

The compensating mechanism consists of a pair of arms hinged to the beam near the upper end, and secured to one end of a cable, which passes over a sheave at the top of the beam, and then runs to a point on the frame where it is permanently secured. As the beam is moved backward or forward, the arms are correspondingly swung on their hinges, so that their outer ends trace a practically horizontal line. At these outer ends the arms support the upper blocks of the hoisting tackle over which the hoisting cables run to a pair of winding drums. As a result of this "parallel motion" the load is not materially lifted as the crane is swung upward, and the bending moment on the beam is greatly reduced.

The accompanying illustrations show a model of a full-sized 4-ton crane, which has a lifting capacity of 2½ tons. In this crane the actual reduction in bending moment of the beam due to the compensating device is five-sixths; that is, a load of 120 foot-tons is reduced to 20 foot-tons, while the maximum thrust on the screw is less than 2¼ tons. The screw may thus be regarded as a simple controlling device rather than a means for shifting the load, the load being practically balanced. There is no bending moment on the screw, the thrust being exerted in line with its axis. In use the crane is provided with separate motors for actuating the screw and the winding drums, and the gear by which the crane is swiveled on its base. Thus the crane is self-contained, making it a very serviceable piece of machinery for docks, ships, wrecking cars, etc. It is the present practice in the construction of buildings to operate the cranes from a plant on the ground floor. Greater facility of operation would be afforded by the use of self-contained cranes, particularly in tall buildings.



**Novel crane with traveling fulcrum and compensating device for moving the load on a horizontal line as the crane beam is raised.**

### Another Confederate Patent

IN the SCIENTIFIC AMERICAN of November 4th appeared a reproduction and account of a Confederate Patent No. 13. We have just examined a reproduction of another Confederate patent, which except as to names, number, title, date and signatures is like that already published, so its reproduction would not be interesting. This other patent is No. 149, issued February 18th, 1863, to D. W. Hughes of Arizona, and disclosed an improvement in breech plugs. An illustration accompanied the patent, in style and execution quite similar to the patent drawings of to-day. The patent describes a removable plug of a breach loading cannon, the plug having radially projecting lugs which turn into interlocking engagement with seats in the bore of the gun. The patentee, D. W. Hughes, is still living at the age of 83 at 437 North 3rd St., Hamilton, Ohio. Mr. Hughes' patent, like the earlier patent No. 13, above referred to, is signed by Rufus R. Rhodes as Commissioner of Patents. Mr. Rhodes was a former official of the United States Patent Office, having been appointed an assignment examiner on June 20th, 1857, and promoted to principal examiner in July, 1858. He resigned February 15th, 1861. The patent No. 13 was issued August 23rd, 1861, just a little more than six months after Mr. Rhodes left the United States Patent Office.

### A New Patent Office Ruling on Perpetual Motion Machines

ALTHOUGH it might be supposed that the absurdity of perpetual motion had been completely exploded long ere this, every patent lawyer can cite numerous cases to show that even in this twentieth century of alleged scientific enlightenment many a deluded inventor is still trying to get a mechanical something out of nothing. To the credit of the patent profession at large be it said that the inventor is usually told that he is wasting his time and his money. It is frequently difficult, however, to convince an inventor that his schemes are impracticable, so that many an attorney, much against his will, is compelled to prepare specifications and claims which relate to an invention that is inoperative.

In the past it has been the practice of the Patent Office to demand a working model from the inventor of perpetual motion machines. The man who can not be convinced by an attorney that his machine is inoperative is not likely to be discouraged by any such requirement. The result is that many an inventor spends hundreds and perhaps thousands of hard-earned dollars in trying to build an operative perpetual motion model—a task which any one with an elementary knowledge of mechanics can tell him is hopeless.

To meet this peculiar situation the Patent Office has now made a ruling which must commend itself to every member of the patent bar, as well as to those engineers and inventors who come into frequent contact with the Patent Office Examiners. The Commissioner, in order to spare the inventor the necessity of parting with at least the government fees for an application, which must inevitably be rejected, has decided that hereafter no application for a patent on a perpetual motion machine will be considered at all unless a working model is filed in the very first place.

The exact wording of the Commissioner's ruling is as follows:

"The views of the Patent Office are in accord with those of the scientists who have investigated this subject and are to the effect that such devices are physical impossibilities. The position of the Office can be rebutted only by the exhibition of a working model. Were the application to be forwarded to the Examiner for consideration, he would make no examination as to the merits, but his first action would be the requirement that a working model be filed.

"In view of all circumstances, the Commissioner has instructed that applications for patent on Perpetual Motion, complete in all other particulars, shall be held in the Application Rooms as incomplete until a working model has been filed. Such model must be filed within one year from the date of application, or the application will become abandoned. The Office hesitates to accept the filing fees from applicants who believe they have discovered Perpetual Motion, and deems it only fair to give such applicants a word of warning that the fees paid cannot be recovered after the case has been considered by the Examiner.

For these reasons it has been thought best to meet the inventor at the threshold of the Office, and give him an opportunity to recover the moneys paid into the Office, in the event of his failure to comply with the requirement."

Although misguided inventors may still persist in spending their money in attempts to furnish working models, there is much consolation to be found in a ruling which, at least, saves them the government fees on a hopeless application.

## Notes for Inventors

**Tool for Attaching Wheel Tires.**—A tool is shown in patent No. 1,007,640 to James L. Butler, Akron, Ohio, assignor to the American Tire & Rubber Co. of Akron, for attaching a tire casing to a rim over compressible cores such as are now used in some tires. The tool has a chain passed around the tire and rim and connected with a main lever so that the operation of the main lever may compress the casing and core, and the main lever is provided with a jaw to press the hooked edge of the casing into engagement with the rim flange and also means to guide it into such engagement.

**A Self-returning Exercising Dummy.**—In patent No. 1,007,628 to Wm. P. Armstrong, Washington, D. C., assignor to The Strong Arm Mfg. Co., is shown a dummy figure in the form of a man mounted so it can be rocked on a weighted base which has a rolling surface the bottom of which is flat so that the figure when knocked one way or the other will persistently tend to maintain or regain a fixed position. A weight is connected by a suitable guided cord with the head of the dummy, thus aiding in the readjustment of the figure to its normal upright position.

**For Teaching Aviators.**—Patent No. 1,007,467 to Wm. F. Mangels of New York city is for an apparatus for teaching aviation and for testing aeroplanes and includes a car on a track and means for running the car at approximately the same speed as the aeroplane. On the car is a frame and in the frame is suspended a power driven aeroplane and its operator, so the aeroplane can to a limited degree move laterally and lengthwise in the frame as well as up and down so the operator can drive the aeroplane at any speed and steer it in any direction, the car and its frame preventing dangerous accidents.

**Drying Wood by Electricity.**—Alfred Upton Alcock of Perth, Western Australia, in a patent No. 1,007,513 provides an electric apparatus for drying timber, which includes liquid electrodes adapted to engage the ends of the piece of timber to be dried, a source of electricity and conducting wires which lead from said source and have their free ends immersed in the liquid electrodes to form a circuit.

**A Novel Toy.**—Many of us can recall trotting, when small, on the foot of some older member of the family who crossing his knee would seat us on his foot and jounce us up and down. A toy (patent No. 1,008,547 granted to Claudius B. Johnson of Fulton, Mo.) simulates this action by means of two figures, one representing an elderly person sitting with crossed leg and the figure of a boy on the raised foot, the leg being pivoted and a counterbalancing weight being within the body of the larger figure, so that the figure of the boy can be trotted up and down for a considerable period.

**Demand Abroad for Smoke Consumers,**—U. S. Consul Carl Bailey Hurst, Lyon, France, writes that owing to an increase in the smoke nuisance a municipal order has been issued at Lyon calling attention of manufacturers and others to an ordinance of a few years ago with relation to thick black smoke. The consul adds: "There seems to be an opportunity of introducing in this vicinity smoke-consuming systems or devices. Any printed matter advertising such will be displayed in this consulate, and brought to the attention of those most likely to be interested."

## RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

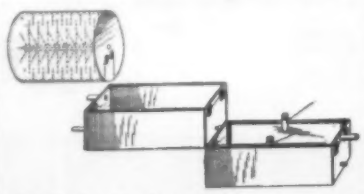
### Electrical Devices.

WAVE DETECTOR.—T. H. LYON, The Preygen, 32 Morris Road, Southampton, England. This invention relates more particularly to wave detectors of the kind known as rectifiers and which employ crystalline or crystalloid substances to be energized by electric oscillations and which may be employed in connection with wave meters as well as in the commercial and experimental sending of messages in wireless telephony and telegraphy.

### Of General Interest.

FOLDING RACK.—J. KOHN, 117 W. 10th Street, New York, N. Y. This invention refers to racks, such as are used in garment factories, stores and other places for supporting and displaying garments. The object is to provide a folding rack which can be readily extended for safely supporting and displaying garments or other articles, or which can be folded when not in use to take up very little space.

PROCESS OF REMOVING INK FROM PAPER.—JOHN E. BONSER, care of Morning News, Abilene, Texas. This invention is illustrated in the accompanying engraving which is a diagrammatical view showing the apparatus that may be used in connection with



APPARATUS FOR REMOVING INK FROM PAPER.

the process. The process removes printers' ink and analines from news, rag, linen and bond papers, and pulps thereof. The aim is to provide a process which will effectively remove the inks from papers so that the latter may be used again in the manufacture of other papers. A further object is to provide a process which is comparatively simple and of great economy.

LOCK BLOCK FOR PAPER ROLLS.—J. L. ORR, 400 Victoria Avenue, Lynchburg, Va. In this case the invention is an improvement in plugs or brushes for use in paper rolls, being in the nature of a lock block which when inserted in the end of the paper roll will be locked therein from accidental displacement and will remain in position until the roll of paper has been used up.

FRUIT PICKER'S LADDER.—T. O. HUTCHINSON, Walterville, Ore. The design is to furnish a ladder adapted for use in picking fruit and for use by painters and builders in any building operations, and the invention provides a ladder including a movable platform easily adjustable to various heights for the purpose of picking fruit, erecting cornices, weatherboarding and painting houses, sanding, sign-writing and other work requiring the workmen to be elevated above the ground.

COMBINATION COAT, HAT, PACKAGE, AND SATCHEL CABINET.—W. H. JAY, Arcade Hotel, Le Beau, S. D. The aim in this improvement is to provide a cabinet having a locker, and also having a satchel fastener arranged at the outside of the locker, and in which access to the locker, removal of the garment from the support, and the detachment of the fastener are controlled by a single lock on the door of the cabinet.

COMBINED DRYING AND CONVEYING SYSTEM.—A. GNADT, 2703 South Seventh Street, St. Louis, Mo. This invention relates to a system for utilizing waste heat from a battery of boilers or the like, in drying any material, such as salt, saw-dust, or the like, while conveying it from one point to another. The system is readily accessible for the purpose of cleaning and manipulation.

PACKAGE.—W. L. BRETHERTON, care of W. A. Clark, Titanite Explosive Co., Corry, Pa. This invention has in view a tubular container which is water-proof and which can be inexpensively produced, the tube being constructed of paper or strawboard, or equivalent material, and given a coating of paraffin containing other ingredients of a water-proofing character.

### Heating and Lighting.

ACETYLENE GAS LIGHTER.—H. VAN HOEVENBERG, Lake Placid Club, Lake Placid, N. Y. The invention comprehends an electrically-operated gas lighter having two movable contact arms and mechanism connected with said arms for actuating the same, the parts being so arranged that the contact arms are brought into engagement with each other, a current is completed through them, and the arms are next separated in or near the path of the flame and are finally brought back to their respective normal positions, the arms thus making an idle contact, but without closing the electric circuit.

### Machines and Mechanical Devices.

SAFETY DEVICE FOR ELEVATORS.—S. F. GLIMM, 3508 Avenue F, Brooklyn, New York, N. Y. This device is for use on passenger and other elevators. The invention refers more particularly to a device comprising in combination a lock for preventing the movement of the elevator car, means whereby the operator of the elevator can control the lock, and means controlled by the elevator door or other closure for controlling the first-mentioned means.

REVERSING MECHANISM FOR POWER DRIVEN MACHINES.—C. FREDRICKSON, Rice Lake, Wis. Among the principal objects which the present invention has in view are: the provision of a simple, efficient and durable means for varying the speed in transmission from a driving to a driven shaft; and to provide a mechanism of the character set forth, simple and effective in operation. The mechanism may be used in conjunction with any suitable machine.

MOLD FORMING MACHINE.—C. E. SIMPSON, 640 Gallia Street, Portsmouth, Ohio. This continuously automatic acting machine employs an endless chain of carriers provided with pattern plates adapted to receive and deliver molding frames for the formation of drag and cope molds; it has a series of successively connecting pattern plates and an intermittent feed mechanism arranged to advance each of the plates to and from stations where the facing sand and ramming sand are delivered to the mold and to a station where the sands are rammed.

FEED TABLE FOR TENTERING MACHINE.—B. PARKINSON, East Greenwich, R. I. The principal purpose of which the present invention has in view is to provide tension devices for feeding the cloth to the reciprocating bed of a tentering machine, and a take-up mechanism for lifting the slack of the cloth due to the return of the bed of the tentering machine constructed as mentioned.

MECHANICAL EYES.—P. C. JACQUEROD, West New York, N. J. In the present patent the invention has reference to mechanical eyes for dolls, lay figures, or other use. The object of the improvement is the provision of a practicable construction whereby the eyes may be capable both of the ordinary opening and closing movement, and of moving laterally.

### Prime Movers and Their Accessories.

IGNITER FOR INTERNAL COMBUSTION ENGINES.—C. MESSERSCHMID, 696 Bergen Street, Brooklyn, New York, N. Y. This invention is an igniter or spark plug for gas and other internal combustion engines which is designed to operate on high and low tension circuits. It is provided with a pair of jump spark electrodes and a pair of make-and-break spark electrodes operable exchangably, according to conditions. The last named are preferably operated by an electromagnet incorporated with the plug structure. The electrode carries the high tension electrode which extends therethrough and terminates in proximity to a fixed spark point to the inner end of the plug.

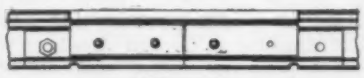
BILGE PUMP.—G. E. BADGER, Mayger, Ore. In this case the aim is to provide a rotary pump for launches, which is driven by a friction wheel which may be thrown into and out of engagement with the flywheel of the engine by a system of levers and connecting rods which are operated by a treadle.

ROTARY MOTOR.—J. MACKEY, Steamboat Springs, Colo. In the motor forming the subject of the patent obtained by this inventor there is a rotor having peripheral blades and mounted on a hollow shaft having a slide valve, controlling openings in the hollow shaft and in the hub of the rotor. An auxiliary casing is mounted on the shaft at one side of the rotor through which the motive fluid passes to the exhaust.

SPARK PLUG.—W. S. WITTER, Toledo, Iowa, in this invention the improved plug consists of a case cylindrical in form and provided with means for engaging an engine cylinder and having a plunger acted upon by the compression and moved in one direction thereby, and in the opposite direction by a solenoid coil of which the plunger forms the case.

### Railways and Their Accessories.

RAIL JOINT.—ARTHUR F. HALL, 180 Crescent Road, Toronto, Ontario, Canada. Mr. Hall's invention relates to rail joints, and it has for its object to provide one which distributes the strain and provides a secure and substantial joint, presenting a smooth and continuous surface to the wheels. Another object is to provide a rail joint which will protect the ends of the rails. The accompany-



RAIL JOINT.

ing illustration presents a side elevation of the invention. The neighboring ends of two rails are indicated by the dotted lines midway the saddle members used with the joint and shown in position. The saddle in connection with the heads of the rail presents a smooth and continuous surface to the wheels, and as the wheels pass over the saddle the strain on the plates is distributed through the length of the saddle, thus greatly reducing the possibility of fracture of the parts.

GRAIN CAR DOOR.—J. C. DOBIE, Onawa, Iowa, and J. L. ROBB, Amistad, N. Mex., care of E. M. Hoover, 808 N. Adams Street, Carroll, Iowa. Among the various provisions of this invention are: To provide in a car a door to preserve the thickness of the wall of the car when the door is open; to provide a door and frame to prevent warping or disarrangement of the door to permit leakage to pass the same; to provide a holding frame for a door to maintain the latter in locked position; to provide a plate-metal sill to support the door and form a guiding track therefor; to provide a door to prevent obstructive lodgment of articles behind the door when the same is closed; and to provide a chute in said door for the handling of grain or flowing freight.

RAILWAY RAIL AND TIE FASTENER.—J. S. SHOFF, 1015 E. 11th Street, Chattanooga, Tenn. This invention is especially adapted for use with reinforced concrete ties. The object is to provide a device which will easily and securely hold the rail in position on the tie. Another object is to provide a means which is cheaply produced and which will consist of few parts, thereby lessening the cost of such devices in railroad constructions.

SPIKE HOLDER.—J. M. POWELL, Los Gatos, Cal. The object here is to provide a holder, having parts thereon for engagement with a tie plate on rail chain and another portion for engagement with the web of the rail, the holder when in normal position being in contact with the head of a spike, whereby the spike is held against loosening and the danger of spreading rails is obviated.

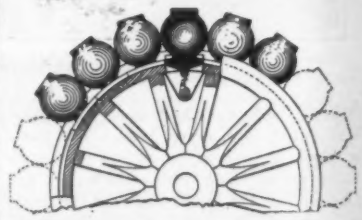
RAILROAD TIE.—J. F. O'NEILL, 159 East Front Street, Trenton, N. J. An object of the inventor is to provide a tie, preferably made of concrete, which tie is composed of a series of parts flexibly fastened together, two of said parts carrying the pair of rails, and so disposed that these parts will give slightly as the wheels of the train pass over the rails.

### Pertaining to Recreation.

SWING.—G. D. TUCKER, Meridian, Miss. The oscilating motion of this swing traverses the support for the swing over the ground. An object of this invention is to provide a support rotatably supported on suitable rollers, with means for driving one or more of said rollers by the swinging action of the swing, so that the device as a whole will move over the ground, and if desired, about a common pivotal point. Another object is to provide means so that the swing may be moved while the device as a whole remains stationary on the ground.

### Pertaining to Vehicles.

COMBINED SECTIONAL TIRE AND WHEEL RIM.—FRANK M. HENRY, 222 McDougal Street, Brooklyn, New York, N. Y. Some advantages over other tires, in this invention, are: 1. In case of puncture it is not necessary to stop and repair, as puncture of one ball will not injure any other part of tire and one can continue to one's destination or can repair at once in a short time. 2. A tire blow-out while going at high speed has caused the loss of many lives and the wrecking of machines. This will not be the case if one of these balls blows out, as the rest of the tire will not collapse. 3. Requires no pumping up. 4. There is no necessity of having a tire chain to prevent slipping. 5. Skidding has been brought to a minimum. 6. Any injured part



COMBINED SECTIONAL TIRE AND WHEEL RIM.

can be replaced without tools. 7. The small cost of a section of this tire in comparison to a new one of any kind. 8. If the saving of a life is the only thing to be considered, it would alone be worth many times the cost of any other tire. Life is worth the price of a sectional safety tire. No one knows when one will be running at high speed and a tire "blow-out" which will wreck the machine and perhaps cost owner and friends their lives or broken limbs. 9. The inventor will sell one-half interest in this patent to further its progress and will take out patents in four European countries. A side view of a wheel with sections of the tire in position is shown herewith.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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### PROPOSALS.

PROPOSALS FOR BRICK DORMITORY, CENTRAL STEAM HEATING AND POWER PLANT. Department of the Interior, Office of Indian Affairs, Washington, D. C., November 15, 1911. Sealed proposals, plainly marked on the outside of the sealed envelope: "Proposals for Brick Dormitory, Central Steam Heating and Power Plant, for the Rapid City Indian School, South Dakota," and addressed to the Commissioner of Indian Affairs, Washington, D. C., will be received at the Indian Office until 2 o'clock, p. m., December 29, 1911, for furnishing materials and labor for the erection of a brick dormitory, central steam heating and power plant, at the Rapid City Indian school, South Dakota, in strict accordance with the plans, specifications and instructions to bidders, which may be examined at this Office, the offices of the Supervisor of Construction, Denver, Colorado, the American Contractor, Chicago, Ill., Scientific American, New York City, the Improvement Bulletin, Minneapolis, Minn., the Journal, Rapid City, South Dakota, the Bee, Omaha, Nebr., the United States Indian Warehouses at Chicago, Ill., St. Louis, Mo., and Omaha, Nebr., the Builders and Traders Exchange at St. Paul, Minn., and at the school. For further information apply to the Superintendent of the Rapid City Indian School, Rapid City, South Dakota. C. F. Hauke, Acting Commissioner.

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PATENTS FOR ENGLAND.—If you have a successful invention, and a British Patent for same, I will negotiate a license if terms are reasonable. Address "London Consulting Engineer," Box No. 773 N. Y. City.

## Notes and Queries.

**Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.**

(12576) L. W. asks: Will you please give me a clear definition of "power factor" and "KVA," expressions used in electrotechnics, and illustrate same by example? A. "The 'power factor' of an alternating current circuit, or apparatus, is the ratio of the electric power in watts to the apparent power in volt-amperes." This is the definition as given in the Standardization Rules of the American Institute of Electrical Engineers. It is official. The true power of an alternating current divided by the apparent power, which is the volt-amperes entering the apparatus, gives the power factor. The volt-amperes apparently entering the apparatus multiplied by the power factor give the true power of the apparatus. The apparent power is the KVA, the kilo-volt-amperes. You will find this fully explained in Sloane's "Handy Book," which we can furnish you for $3.50.

(12577) W. D. C. asks: Why does the honeysuckle vine grow to the left just contrary to the growth of all other trailing vegetation? All vines seek the sun or grow to the right, except the honeysuckle. Why is this? A. Many plants twine in the spiral of a right-handed screw, or "against the sun," or "from left to right." The common garden bean and the wisteria have this habit. Other plants like the hop and honeysuckle twine in the opposite direction, presenting the spiral of a left-handed screw. A most interesting account of these phenomena will be found in Darwin's "Movements and Habits of Climbing Plants."

(12578) F. L. Y. asks: How high does a person have to go before the earth becomes invisible to the sight? A. Any object is just visible which fills one minute of arc. The earth will subtend an angle of one minute at a distance of a little more than 27,000,000 miles, and hence would be visible as a point at that distance, but would not show any disk.

(12579) D. E. says: I notice in a recent number of your paper an item in which you say that some process of restoring the appearance of a felt hat, that had become somewhat rusty, would fill a long "felt" want. I have solved this problem by wiping my hat with the same cloth I polish my shoes with. The blacking I use does not "crock" when applied to the hat, and an occasional application keeps it looking nice.

(12580) R. F. McK. says: Please give me a solution of the following: If a tube 3 feet high and 6 inches in diameter is filled with water, and has a plunger in the bottom 1 inch in diameter, will the force required to push the plunger up in the tube 1 inch equal the force required to lift a column of water 1 inch in diameter and 3 feet high to the height of 1 inch? A. The pressure of water in the tube is equal in all direction at any given point. At the moment your plunger starts to rise, it is resisted by a head of 3 feet of water, that is, by the weight of a column of water 3 feet high and the area of the plunger. But as the plunger rises, the height of the column decreases. If you had a tube around the plunger, raising the plunger 1 inch would raise the whole body of the water in the tube 1 inch, and the plunger would operate under a constant pressure equal to 3 feet head of water; but in the illustration you give the rise of the plunger of 1 inch will cause a very much smaller rise of the surface of the water, so that when the plunger has completed its lift of 1 inch it will have little more than 35 inches of head of water above it, and the average pressure will therefore be about 35½ inches of water. Obviously, if your plunger traveled the whole 3 feet and came to the surface of the water at the completion of the 3-foot travel, there would be no pressure against the plunger due to water head, since the plunger would emerge from the surface of the water. Similarly, the pressure on the plunger decreases with every inch of its travel upward.

(12581) J. C. J. asks: If a substance could be found which is heavier than water and *less compressible*, would it sink in any depth of water? A. If a substance could be found which is slightly heavier but less compressible than water, it might sink in water till it had reached the place where it was of the same density as the water at that place and there remain. The water at the bottom of the ocean is about 1/20 denser than at the surface; hence this supposed material could not be as much as 1/20 heavier than water at the surface of the ocean. No such material is known to exist.

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## The American Merchant Marine

To the Editor of SCIENTIFIC AMERICAN:

A correspondent in a recent issue of the SCIENTIFIC AMERICAN set forth the difference in the cost of operation of steamers operated under the United States navigation laws and those which operate under the navigation laws of foreign countries. The higher wages and feeding stipulations are given as the reason that the cost under our laws would amount to something like $6,000 on the average sized tramp plying in foreign trade against the American owner, even though the laws allowed him the privilege of buying foreign tonnage and securing American registration. This is true. But why should our navigation laws compel an American citizen to employ American crews in foreign trade? Even under the present subsidy laws under which a few American lines operate, the number of Americans employed is limited. Why should not an American shipowner have the same right to employ whom he pleases as has an American railroad builder or any other employer of labor?

This year we have the greatest movement in export cotton that the United States has ever seen. All moving in foreign tonnage. Our Gulf and West Indian trade is constantly increasing and it is practically carried on with foreign built and owned tonnage. The earnings of foreign tonnage this year due to the immense export movement from the United States as well as from goods imported will be tremendous and the various owners and investors abroad will receive heavy dividends. As the United States are not investors in foreign shipping, nothing will come to this country for distribution in the way of dividends. In this great fleet that operates under the flags of foreign nations, is no American sailor. Under present conditions we pay the freight, but we distribute nothing in the way of dividends to Americans.

Our navigation laws say that we must employ so many sailors on American ships—so many according to the tonnage of the ship. Yet the navigation laws have killed American shipping in foreign trade. Hence there are no American sailors in foreign trade. Of what benefit are the navigation laws?

There is another statement that your correspondent made, and like many similar statements of an erroneous nature, retards the solution of the restroation of the American flag to the deep sea trade. The particular statement that I now refer to is that the "German government guarantees a dividend to the North German Lloyd of 7 per cent on its stock." Of course this is taken as subsidy payment and if it were true it would be a subsidy, but it is not, but it is astonishing that such statements continue to be made when the truth can readily be ascertained. Now the facts are that the North German Lloyd paid 3 per cent dividend last year and 1½ per cent the year before and before that nothing. The North German Lloyd is pre-eminently a passenger line and in the panic of 1907 cut into its earnings heavily. Fast passenger steamers have their advantages for the United States trade as well as they have for foreign, and fast steamers under the American flag are desirable.

It might be well held, that for certain routes, under the American flag, mail subvention is necessary to enable the American line to establish itself, but this policy has been so far ineffective because of the extraordinarily higher cost of building in the States as compared with the cost of the foreign builders, and this condition will have to be adjusted ere the mail subvention act will have any beneficial influence on the shipping industry of the United States. The one thing that will stimulate American interest and investment in shipping is to give Americans the right to engage in the world's commerce on the same terms that favor foreigners. Give the right to an American to buy a foreign steamer and grant it American registration. Give him the freedom as to crews that foreign steamship owners enjoy. Compel him to have American officers. Steamers so registered to engage in foreign trade only.

To-day we have practically no American steamers engaged in foreign trade and no American sailers, so the continued opposition to a free ship policy is difficult to understand. We can hurt no American interest in foreign shipping as there is no American interest to be hurt. If it hurts any interest it will be that of foreign steamship interests.

Why is the present policy continued? Possibly in the hope that the Americans will be willing to allow a wide-open subsidy bill to finally become a law, and possibly to the fact that shipping generally is but little understood by the American people. But the interest is growing and growing rapidly and the interest taken in the Panama canal is stimulating investigation. Ere the Panama canal is opened it will be recognized that the restoration of an American merchant fleet to the deep sea foreign trade is but second in importance to the tariff as an issue in which the country is vitally concerned.

Some time ago President Bowles of the Fore River Shipbuilding Company stated that it would take ten years to build a fleet that would carry the sea commerce of the year 1910. Yet all the time our over-sea commerce is increasing yearly. It has recently been given out, that our domestic shipyards with government work and the orders for steamers to be ready for operation on the opening of the Panama canal, have all the work they can handle. What then shall the American people do? Rest quiet and allow foreign shipping nations to reap the benefit of our investment of $400,000,000 in the Panama canal? Is that what the United States built the canal for?

Let the American people answer.

Chicago, Ill. CHARLES DEPRESEE.

## The Technique of Clam Digging

To the Editor of SCIENTIFIC AMERICAN:

"It pays to advertise" is something we often hear, and it certainly does; but the statement you made in a recent ad. in the *Literary Digest* regarding the technique of clam digging does not add any luster to an advertisement, as it is so very evident that the party who wrote the ad. was a long way off from his subject.

Now, this is not in the sense of a knock, for only people who live along the coast are supposed to know anything about digging clams in the commonly expressed sense of the words. Everybody who lives in the Puget Sound region has an opportunity to know that you do not dig clams out of a boat with a rake, and I presume that our eastern clams have the same habit of keeping far below the rake's reach.

I like the SCIENTIFIC AMERICAN so well that I dislike to see any misstatement of this sort, therefore I am telling you that the way we dig clams in this country is to take a good stout spade or fork, and go down to the beach when the tide is out, and get busy just the same as you would to dig potatoes. Still, perhaps I should explain to the man who wrote the ad. that you do not dig potatoes with a hayrake. In any event, I hope the information will be of some use, as it is given in all good friendship.

Seattle, Wash. HUGH N. JOHNSON.

## The Current Supplement

IN the present issue of our SUPPLEMENT, No. 1876, Prof. Woodworth discusses the Psychology of Light or, in other words, the subjective aspect of the science of optics. Mr. Coleman contributes an article on modern methods of bunkering steamers. A very interesting topic treated in this number is that of fireless locomotives. Malaria is one of the most widespread diseases, and its study has of late been receiving a great deal of attention, with results which are most gratifying. Some facts about malaria, derived from Dr. Howard's govern-

ment publication, and a summary prepared by Sir Roland Ross, are presented in this issue. Many have marveled at the extraordinary power which carrier pigeons possess of finding their way back to their home. A scientific discussion of the *modus operandi* of this remarkable performance is discussed in an article by M. Tevis.—Insect aviation presents certain features which are not as yet incorporated in artificial aviation as practiced by man. The subject is lucidly expounded in an illustrated article derived from *La Nature*.—The Sixty-Inch Reflector of the Mt. Wilson Observatory is briefly described.—An article reproduced from *Engineering* tells how the government aids the man out-of-work in France.—A. P. Thurston discusses from a scientific standpoint the stability of aeroplanes.—We have become accustomed to the term "plant psychology." The senses of plants forms the subject of a brief article derived from *La Revue*.—Major Squier, the originator of the system, describes the use of wire directed electric waves in multiplex telephony and telegraphy.

## The Strength of an Aeroplane

*(Concluded from page 552.)*

other is to allow streams of smoke to flow past the model. Both methods show the direction of flow at all parts of the current except where the eddies are so violent as to make the thread flutter and the smoke streams break and lose their identity. The thread is more convenient to use than the smoke, but if too long will not accurately coincide with the stream-line, owing to the effect of tension. The smoke coincides with the direction of flow at all points, and, as Prof. Marey has shown, may even indicate the velocity at all parts of the current, if the smoke-streams be emitted from nozzles vibrating at a known rate transversely to the current. In this case the smoke streams are wavy, and show by the number of waves per inch what is the speed of the current at the place of observation. The number of waves per inch can easily be counted on a photograph of the model and of the smoke-streams surrounding it. Indeed, the velocity and direction of flow for an entire longitudinal section of the current about the model may be realized by a glance at the photograph if the smoke streams surrounding it. Indeed, the comb placed transversely to the current and vibrated lengthwise, say ten times per second, as done by Marey.

Mr. Curtiss is at present trying different methods of producing distinct and clearly visible lines of smoke. At first air was sucked over the surface of ammonia in a bottle, thence over hydrochloric acid in a second bottle, thence through holes in a tube placed across the wind current. But the smoke so produced is pale and requires good lighting in a dark wind-tube to render it distinct enough for easy observation and photography. It is hoped that a simple method may be found whereby dense black smoke streams may easily be produced and led into the current.

The absolute velocity of the air in the Curtiss wind-tube was found by a screw anemometer to be about 25 miles per hour at the middle of the current. The relative velocity at different parts of a section of the current was found by observing the deflection produced on a straight exploring wire, like a knitting needle, ten inches long, suspended from a horizontal wire fixed transversely to the stream. When the point of suspension of the exploring wire was moved across the tube, the suspended wire was deflected from the vertical less and less as it advanced from the mid section toward the lateral wall. The impact pressure of the air against the wire is proportional to its displacement along any longitudinal line of the current. Hence, of course, the velocity is as the square root of such displacement. In this manner the speed of the current was observed to decline about two per cent from midstream to within two inches of the lateral wall, as previously stated.

The wind-tube and tension tongs described in this article were designed by Mr. Curtiss and Dr. Zahm, who were experimenting together. Two other contrivances were devised for finding the tension in aeroplane wires; one being an instrument for giving the pitch of the wire in vibration, the other being an in-

strument for showing the lateral displacement of the wire by a given force, from which the tension could be read in a reference table or along a specially designed index scale.

### Some Locomotive Curiosities

*(Concluded from page 559.)*

were connected by crossed rods as will be understood by examining the illustration. This engine never did practical work. It was jacked up clear of the ground and tried under steam in January, 1856, at Kew, near London, where it was sharply criticized by some engineers. The writer saw it in the early sixties when it was fast rusting away in the stable yard of an inn near Kew Bridge.

Double piston balanced locomotives were patented by Bodmer in 1834, and some engines were built for English railways in 1842. The rod of one piston worked within the hollow rod of the other and they were connected to oppositely disposed cranks, which were four in number. As the mechanism was internal and the appearance of the engines differed in no wise from the ordinary locomotives of the day, they are not illustrated here.

The next remarkable locomotive selected is illustrated in Fig. 6. This engine was a partial repetition of the "Hurricane" (Fig. 2) for the boiler and running gear were on separate frames. It was designed for the Philadelphia and Reading railroad by G. W. Nicholls and was put to work in 1847. This engine was appropriately named "Novelty." The cylinders were 18 inches in diameter by 20 inches stroke. Driving wheels 8 feet 10 inches in diameter. The weight of the engine proper was 21 tons, and the frame carried a cylindrical iron water tank which had the appearance of a boiler. This was used as a condenser and feed water heater, while the boiler was carried on a separate frame behind the engine. This, in turn was coupled to a tender which does not appear in the illustration. The boiler had return flues and burned anthracite coal; it had a total heating surface of 1,085 square feet. The fire was urged by a fan placed in the cab. The condenser tank was surmounted by a large smoke stack, but as nothing passed through the latter save the surplus exhaust steam from the condenser it was apparently placed there merely for appearance. Steam was carried from the boiler to the engine by a jointed pipe. This engine hauled coal trains of 750 tons at 10 miles an hour. This complicated piece of machinery only worked for a short time.

Complicated machinery is not, in itself, objectionable, and when complication enables a necessary function to be better performed it is allowable; but one can scarcely see how such a machine as is illustrated in Fig. 8 could have been seriously considered in the light of modern practice. Nevertheless, this engine was built in 1881, and ran on the Canada Southern Railway. It was designed by Eugene Fontaine. The cylinders were 16 inches diameter by 24 inches stroke. The engine weighed about 40 tons. The driving wheels were 6 feet in diameter, having frictional contact with wheels 4 feet 8 inches in diameter, which were integral with wheels 5 feet 10 inches in diameter running on the rails. In other words, instead of propulson by power applied directly to the rails as in the common locomotive, two extra wheels were interposed to effect the same result. The "Fontaine" was a fast engine, for it drew two coaches 111 miles in 98 minutes, but many ordinary locomotives traveled faster with heavier loads. Geared engines were tried as far back as 1838, but it was then found that a gain in speed meant a loss of power, and as locomotives are required to haul loads, these engines were short lived. The "Fontaine" engine was not original, as the same arrangement was patented in England by Johnson in 1848.

The foregoing notes will, perhaps, give a good illustration of the adage that "History shows us what to avoid."

### Caryl Davis Haskins

CARYL DAVIS HASKINS, one of the best known electrical men of this country, died Saturday morning, November 18th, in Salt Lake City. Mr. Haskins

was stricken with pneumonia while on a business trip in the West and the end came very unexpected.

Mr. Haskins was born in Waltham, Mass., May 22nd, 1867, and was educated in England where he specialized in mathematics and physics and took a special course in surveying and fortification work. In 1888 he entered the employ of the S. Z. de Ferranti & Company as one of its junior assistant engineers, where he had charge of the manufacture of electrical meters and assisted Mr. de Ferranti on the drawings for the original Deptford electric light station.

In the autumn of 1889 he was a designing draftsman in the Thomson Electric Welding Company, Lynn, Mass. Two or three months later he was employed by the Thomson-Houston Electric Company, Lynn, Mass., as an electrical engineer. In 1891 he was appointed manager of the Meter Department of this company and after its consolidation with the General Electric Company, Mr. Haskins retained this position, including general supervision of the engineering and the manufacture of instruments.

At the beginning of the Spanish-American War Mr. Haskins proffered his services to the government and organized a corps of electrical engineers and men trained in electrical work, of which he was made commander. In the laying of the submarine mine defenses of Boston Harbor, the erecting of search light and range finding stations and other similar work during the war, Mr. Haskins and his command gave valuable service. He also gave invaluable aid in an advisory capacity in connection with other defense work on the north Atlantic coast. Under his supervision the temporary generating stations at Fort Warren and Fort Nahant were erected as well as all the range finding and communicating stations on the New England coast. The work in Boston Harbor involved the charging and laying of some 200 mines. At the conclusion of the war, Mr. Haskins resumed his position with the General Electric Company. He had made a special study of electricity as applied to offense and particularly defense in time of war and was considered an authority on this subject. After the close of the war he frequently acted in an advisory capacity to the government in matters of this nature.

Mr. Haskins was a member of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, of the National Electric Light Association, and associate member of the Military Service Institute and the U. S. Naval Academy.

### NEW BOOKS, ETC.

PHYSIKALISCHE ZEITSCHRIFT. 12. Jahrgang. 1911. Seite 540-546. Struktur und Optik grosser Kristalltropfen. Von O. Lehmann.

KONISCHE STRUKTURSTOERUNGEN BEI FLUESSIGEN PSEUDOKRISTALLEN. Von O. Lehmann. Sonderabdruck aus den Verhandlungen der Deutschen Physikalischen Gesellschaft. XIII. Jarhgang. Nr. 8. Braunschweig: Druck von Friedr. Vieweg & Sohn, 1911.

UBER MOLEKULARSTRUKTUR UND OPTIK GROSSER FLUESSIGER KRISTALLE. Von O. Lehmann. Separat-Abdruck aus den Annalen der Physik. Vierte Folge. Band 35. Leipzig: Johann Ambrosius Barth, 1911.

DIE UMWANDLUNG UNSERER NATURAUFFASSUNG INFOLGE DER ENTDECKUNG DES RELATIVITATSPRINZIPS. Von Geh. Hofrat Prof. Dr. O. Lehmann, Karlsruhe. Vortrag gehalten im Karlsruher Naturwissenschaftl. Verein am 2 December 1910.

DAS RELATIVITATSPRINZIP DER NEUE FUNDAMENTALSATZ DER PHYSIK. Von O. Lehmann. Sonderabdruck aus dem 23. Band der Verhandlunger des Naturwissenschaftlichen Vereins. Karlsruhe: Druck der G. Braunschen Hofbuchdruckerei, 1910.

These publications contain careful studies of Prof. Lehmann's investigation of liquid crystals. If there can be any doubt that our definition of the word "crystal" must be revised, surely Lehmann's work must dispel it.

DER MENSCH DER VORZEIT. Von Wilhelm Bolsche. Stuttgart: Kosmos, Gesellschaft der Naturfreunde, 1911.

In this simply worded book the author gives the more important results of modern research on the subject of prehistoric man.

# ANNUAL MOTOR NUMBER

## MOTOR CARS MOTOR TRUCKS MOTOR BOATS MOTOR CYCLES

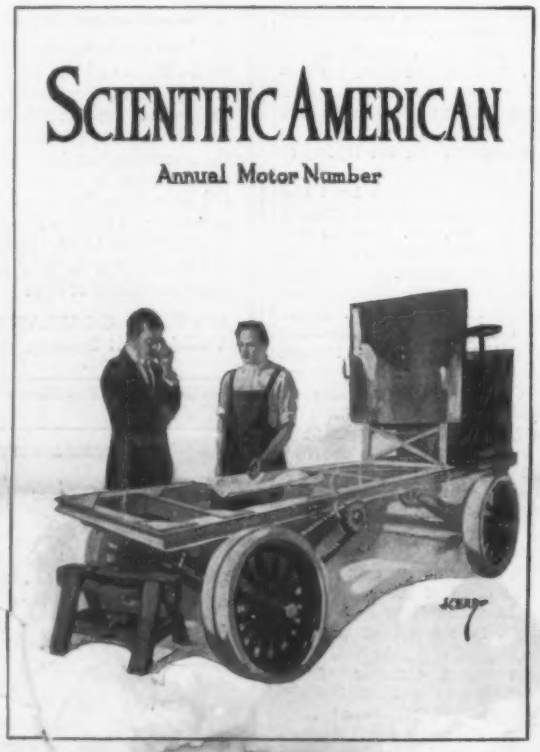
JANUARY MAGAZINE NUMBER OF THE SCIENTIFIC AMERICAN

ISSUE OF JANUARY 6, 1912

Although we are well past the dawn of the "hydrocarbon age," we have not yet reached the meridian period. Each year there are new developments making for the betterment of motor-driven land and water vehicles. The improvements that are to be brought out in 1912 are exceptionally interesting and will be outlined in detail in this number. The following articles will appear:

### Selection of a Motor Truck

In what respect do leading types of motor trucks for 1912 differ mechanically? How can the owner best protect his investment? What are the costs of upkeep and operation as compared with those of horse-drawn trucks? Can truck chauffeurs be made of ordinary teamsters? These are vital questions to the intending purchaser of motor trucks, which will be ably discussed.




### Will Rubber Tires be Supplanted?

While tire manufacturers are doing everything that is humanly possible with rubber and fabric, yet, undoubtedly, there is no feature of a motor car that gives the owner more concern than the tires. The ability of rubber to stand up under the terrific shocks and wearing grind of service is a marvel. Hundreds of inventors have been busy at the task for years, no substitute for the rubber tire has yet been developed to such a degree as to supplant the standard pneumatic tire. Just what has been done in the past, and what promises are held for the future, will be brought out in this article.

### The New God of War—Gasoline

In this article the prominent place occupied by the automobile in European military maneuvers is described. In the United States the armored automobile has been entirely neglected. In Germany in time of war every car in the country, private as well as public, is placed at the beck and call of the Government.

### Auxiliary Uses for Motor Vehicle Engines

Herein are described a number of novel uses for the engine of a motor truck or an automobile.

### The Comparative Cost of Light and Heavy Cars

This question is debated by a man who has made painstaking and impartial comparison of every detail of his personal expenses in connection with two cars, one a typical light car, and the other a standard heavy car.

### Making the Starting Crank Obsolete

One of the most noticeable features of the 1912 car will be the absence of a starting crank in front of the radiator. The desirability of providing a means for starting the car from the driver's seat was expressed years ago, and its necessity has been urged more clamorously each year. Now, suddenly, a score of different self-starters have been developed, and the majority of manufacturers are going to bring out their 1912 cars with some sort of a self-starting mechanism. The leading types of self-starters will be explained so that any automobile owner can understand them.

### Driving the Car at Night

To obtain the full value of a motor car, it must be available for service at night as well as during the day time. There is much more to safe night-riding than a pair of powerful headlights. There are new developments which every automobilist should know.

### The Easy Riding Car

The pleasure vehicle has now become so standardized that the riding qualities of an automobile receive much more attention than heretofore. As a consequence, designers have been devoting much thought to the springs, shock absorbers, upholstering, the balance and hang of the body, and all the features that enter into the making of a comfortable car. The prospective purchaser should know that the distribution of weight on a car is an important factor in making it "stick to the road." A badly-balanced car will possess poor traction qualities owing to the tendency of the rear wheels to bounce off the road's surface.

### A Fertile Field for Inventors

Under this subject are detailed many ingenious devices that inventors have developed of late for use on automobiles.

### Lessons in Everyday Motor Boat Designs

The racing motor boat is very properly considered a useless craft for pleasure purposes. In the present article, however, it is clearly brought out that the design of the pleasure boat has been materially improved by the development of the racer.

### Motor-Cycle Developments

What is being done to improve that noisy, sputtering, two-wheeled vehicle? Among the prominent features for 1912 are footstarters, multiple jet carbureters for slower running in cities, improved mufflers, and floating seats to make riding more comfortable.

Price Fifteen Cents on All News Stands